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GEOLOGICAL SURVEY

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey U.S. Department of the Interior

VOLUME 21, NUMBER 10 OCTOBER 1988

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1988.

A sthe Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

S elected Water Resources Appendix, and earlier journal, includes abstracts of current and earlier reports, and elected Water Resources Abstracts, a monthly pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the Water Resources Thesaurus. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific Information Center U.S. Geological Survey MS 425 National Center Reston, VA 22092

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

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08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

CALIBRATION OF WATER-BALANCE MODEL FOR SMALL WATERSHEDS IN EASTERN OREGON, Chequamegon National Forest, Park Falls, WI. D. A. Higgins, S. B. Maloney, A. R. Tiedemann, and T. M. Quigley. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 347-360, April 1988. 2 fig, 7 tab, 17 ref.

Descriptors: *Oregon, *Hydrologic budget, *Wa-tersheds, *Small watersheds, Calibrations, Hydrol-ogy, Model studies, BURP model, Mathematical studies, Prediction, Runoff, Snowmelt, Forest wa-tersheds, Subsurface water, Streamflow.

The BURP water-balance model was calibrated for 13 small (0.46 to 7.00 sq mi), forested water-sheds in the Blue Mountains of eastern Oregon where snowmelt is the dominant source of runoff. BURP is the model name and is not an acronym. Six of the 16 parameters in BURP were calibrated. The subsurface recession coefficient and three subsurface water-storage parameters were most sensitive for simulating monthly flow. Calibrated subsurface-water storage parameters were calibrated at between 20 to 120 percent of their initial values obtained from a category III soil survey. That reconnaissance-level survey was apparently too broad to accurately reflect subsurface-water storage in small watersheds. Tests of model performance showed BURP is capable of producing accurate simulations of monthly flow for mountainous, snow-dominated watersheds with shallow (< 4 ft) soils when calibrated with 2 to 4 years of streamflow data. A regression of observed versus simulated monthly flows with data from all watersheds combined showed that BURP accounted for 85 percent of the variability in observed flows, which ranged from 0.01 to 20.8 inches, but underpredicted high flow months, with a slope of 1.15 that is significantly different from 1.0 (p = 0.05). Without prior calibration, subsurface-water storage parameters appeared to be the greatest source of potential error. (Author's abstract) Six of the 16 parameters in BURP were calibrated. The subsurface recession coefficient and three sub-

DOES EVAPORATION OVER THE ARABIAN SEA PLAY A CRUCIAL ROLE IN MOISTURE TRANSPORT ACROSS THE WEST COAST OF INDIA DURING AN ACTIVE MONSOON PERIOD

PERIOD, National Inst. of Oceanography, Panaji (India). For primary bibliographic entry see Field 2B. W88-08116

PREDICTION OF THE 1979 SUMMER MON-SOON ONSET WITH MODIFIED PARAME-TERIZATION SCHEMES, European Centre for Medium Range Weather Forecasts, Reading (England). For primary bibliographic entry see Field 2B. W88-08117

APPLICATION OF SUPERCOMPUTERS TO WEATHER FORECASTING, Meteorological Office, Bracknell (England). For primary bibliographic entry see Field 2B.

STRUCTURE OF A CONVERGENT CLOUD BAND OVER THE JAPAN SEA IN WINTER: A PREDICTION EXPERIMENT, Meteorological Research Inst., Yatabe (Japan). For primary bibliographic entry see Field 2B. W88-08122

SPACE TRANSFORMATIONS IN THE STUDY OF MULTIDIMENSIONAL FUNCTIONS IN THE HYDROLOGICAL SCIENCES, Institute of Geology and Mineral Exploration, Athens (Greece). G. Christakos.

Advances in Water Resources AWREDI, Vol. 9, No. 1, p 42-48, March 1988. 33 ref.

Descriptors: *Mathematical models, *Hydrologic models, *Groundwater, *Aquifers, *Porous media, Multidimensional phenomena, Space transformations, Mathematical analysis, Fourier analysis.

In the hydrological sciences complex phenomena are often dealt with which take place in several dimensions, such as 2-dimensional distributions of rainfall over a region or 3-dimensional chemical rainfall over a region or 3-dimensional chemical transport within an aquifer. The aim of this paper is to show benefits obtained by use of space transformations in the solution of multidimensional problems. The approach is to transform the original space to a space of lower dimensionality, where analysis is easier and involves less computational effort. In calculations involving isotropic functions, analytically and computationally tractable expressions are available for both the space transformations and their inverses. Particular attention is paid to the frequency domain forms of the transformations and their inverses. Particular atten-tion is paid to the frequency domain forms of the space transformations. Differential equations de-scribing flow through porous media, structural identification of spatially distributed soil variables, and estimation and simulation of hydrologic fields are a few applications where the use of these transforms may be fruitful. Simple examples are included to illustrate the methodology, and some areas of further work are indicated. (Author's ab-stract)

NOTE ON THE REPRESENTATION OF NON-LINEARITY IN RUNOFF PROCESS BY THE GENERAL HYDROLOGIC SYSTEM MODEL, Centre for Water Resources, Madras (India).

T.B. Babu Rao.
Advances in Water Resources AWREDI, Vol. 9, No. 2, p 85-90, June 1986. 6 fig, 1 tab, 18 ref.

Descriptors: *Mathematical models, *Hydrologic models, *Storm runoff, *Rainfall-runoff relationships, *Discharge measurement, *Flood hydrographs, Rainfall, Nonlinearity, Hydrographs.

The parameters of a previously proposed nonlinear model, the General Hydrologic System (GHS) model, examined by using 116 storms in 11 basins. A study of the relationship of storage at peak and peak flow indicates: (1) the existence of nonlinearity and (2) the ranges of nonlinearity and linearity in the runoff process in a basin system. The derivation of the nonlinear term in the model from the storage-discharge relationship, is explained. Graphical multiple correlations and mathematical relationships between model parameters and the naical multiple correlations and mathematical relationships between model parameters and the parameters representing rainfall characteristics were also obtained to facilitate the flood hydrograph estimation due to a future storm in a basin. The storage loop and the surface runoff hydrograph were reproduced using the nonlinear storage equation and the nonlinear surface runoff model, respectively. The derivation of model parameters from the multiple correlations and the mathematical relationships between the model parameters and the parameters representing rainfall characteristics, are explained. (Author's abstract) W88-08182

DERIVATION OF SOME FREQUENCY DISTRIBUTIONS USING THE PRINCIPLE OF MAXIMUM ENTROPY (POME), Louisiana State Univ., Baton Rouge. Dept. of Civil

Engineering.
For primary bibliographic entry see Field 7C.
W88-08183

DIFFUSION HYDRODYNAMIC MODEL (DHM),

Williamson and Schmid, Irvine, CA. T.V. Hromadka, and C.C. Yen. Advances in Water Resources AWREDI, Vol. 9, No. 3, p 118-170, September 1986. 63 fig, 24 ref,

Descriptors: *Routing, *Mathematical models, *Hydrologic models, *Drainage systems, *Overland flow, *Rainfall-runoff relationships, Water-

sheds, Flood control, Diffusion hydrodynamic model, Channel flow, Hydraulic properties.

A diffusion hydrodynamic model of coupled 2-dimensional overland flow and 1-dimensional open channel flow (DHM) was developed. Because of the diffusion form of the governing flow equations used in this model, several important hydraulic effects are accomodated which are incapable of being handled by the kinematic routing techniques which are often used in most watershed models; namely, backwater effects, channel overflow, com-bined overland flow and storage effects, and pondbined overland flow and storage effects, and pond-ing. Because these often ignored hydraulic effects are important in drainage studies involving flood control channel deficiencies and subtle grade dif-ferences between watershed boundaries (e.g., allu-vial fan hydrology), the DHM approach affords the practicing hydrologist a new tool for drainage system evaluations. (Author's abstract) W88-08184

HYDROLOGICAL ANALYSIS OF BASIN BE-HAVIOR FROM SOIL MOISTURE DATA,

Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society. For primary bibliographic entry see Field 2G. W88-08291

RATIONAL FORMULA INTERPRETED USING A PHYSICALLY-BASED MATHEMATICAL MODEL,

Old Dominion Univ., Norfolk, VA. A. O. Akan, and A. A. Al-Turbak. Nordic Hydrology NOHYBB, Vol. 19, No. 1, p 41-52, 1988. 4 fig, 19 ref.

Descriptors: *Rainfall-runoff relationships, *Urban hydrology, *Infiltration, *Hydrology, *Watershed, *Surface runoff, *Model studies, Mathematical model, Rational formula, Infiltration equations, Basins, Free water, Prediction, Catchment basins, Rainfall, Hydrologic models, Kinematic overland flow, Green-Ampt equations

A new interpretation is given for the rational for-mula in view of a mathematical model founded on the kinematic overland flow and Green and Ampt infiltration equations. The potential variability of the runoff coefficient with various rainfall and basin characteristics is demonstrated. However, pasn cnaracteristics is demonstrated. However, using the concept of hydrologic similarity, it is possible to predict the runoff coefficient in terms of several physically-based non dimensional parameters for homogeneous planar, rectangular basins. (Author's abstract)

W88-08293

THREE INSTRUMENTS USED IN RAINFALL-RUNOFF SIMULATION EXPERIMENTS. Academia Sinica, Beijing (China). Inst. of Geogra-

For primary bibliographic entry see Field 7B. W88-08368

MODEL OF RIVER FLOW FORECASTING FOR A SMALL FORESTED MOUNTAIN CATCHMENT,

Kyoto Univ. (Japan). Dept. of Forestry. . Fukushima.

Hydrological Processes HYPRE3, Vol. 2, No. 2, p 167-185, April 1988. 14 fig, 6 tab, 52 ref.

Descriptors: *Steamflow forecasting, *River flow, *Hydrologic cycle, *Hydrographs, *Hydrologic models, *Catchment areas, *Forest hydrology, Mountains, Base flow, Storm runoff, Rainfall, Evapotranspiration, Model studies.

A model for quantitatively expressing the hydrolo-A model for quantitatively expressing the hydrolo-gical cycle in a forested mountain catchment is proposed. This model - HYCYMODEL - is able to predict both short- and long-term hydrographs be-cause the model parameters remain independent of time. It shows a good applicability for ten years of continuous data at both hourly and daily intervals for the Kiryu catchment, a forested mountain basin. Since HYCYMODEL does not need hydro-

Group 2A-General

graph separation between storm flow and base flow, it is a particularly attractive model. (Author's

TEMPORAL AND SPATIAL PATTERNS OF NITRATE LOSSES FROM AN AGRICULTUR-

AL CATCHMENT, Oxford Univ. (England), Geography School. For primary bibliographic entry see Field 5B. W88-086600

NITROGEN INPUTS AND OUTPUTS IN A SMALL AGRICULTURAL CATCHMENT IN THE EASTERN PART OF THE UNITED KING-

Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 5B. W88-08601

TRANSFORMATION OF RAINFALL ENERGY BY A TROPICAL RAIN FOREST CANOPY IN RELATION TO SOIL EROSION. Bristol Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 2J. W88-08602

DYNAMICS OF A TROPICAL FLOODPLAIN ENVIRONMENT WITH REFERENCE TO

ENVIRONMENT WITH REFERENCE FOREST ECOLOGY, Bristol Univ. (England). Dept. of Geography. S. Nortcliff, and J. B. Thornes. Journal of Biogeography JBIODN, Vol. 15, No. 1, p 49-59, January 1988. 3 fig, 2 tab, 20 ref.

Descriptors: *Rain forests, *Forest ecology, *Eco-systems, *Tropical flood plains, Storm seepage, Runoff, Catchment areas, Regional analysis, Groundwater movement, Model studies, Flooding, Overland flow, Tropical regions, Brazil.

The present investigation seeks to illuminate the dynamics of subsurface flow and overland flow in floodplain environments of a small forested tropical catchment near Manaus, Amazonas. There are large areas of floodplain environments within the tropical forest of the region, and these environments play a crucial role in determining the overall dynamics of the catchments, both with respect to the water flow through them, but also the distribution and movement of fresh litter and partially decomposed organic matter on the floodplain. The dynamics of these floodplain environments are considered in relation to the variations in storage dynamics of these floodplain environments are considered in relation to the variations in storage capacity, groundwater fluxes, and saturated over-land flow, together with the magnitude and fre-quency of overbank flow from the stream and the quency of overoans flow from the stream and the contemporary morphology of the floodplain dy-namics may lead to more successful management of tropical catchments both in their natural forest-ed state and when cleared. The results suggest that some revision of the conventional model of flood activity may be required. (Author's abstract) W88-08603

COMPARISON OF NEWTON-TYPE AND DIRECT SEARCH ALGORITHMS FOR CALIBRATION OF CONCEPTUAL RAINFALL-RUNOFF MODELS,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

Water Resources.

J. D. Hendrickson, S. Sorooshian, and L. E. Brazil.
Water Resources Research WRERAO, Vol. 24,
No. 5, p 691-700, May 1988. 5 fig. 7 tab, 42 ref,
append. Hydrologic Research Lab. of the National
Weather Service Project NA85AA-H-HY088 and
the National Science Foundation Grant

Descriptors: *Algorithms, *Rainfall-runoff relationships, "Mathematical models, Newton-type algorithms, Direct search algorithms, Comparison studies, Soil moisture retention, Hydrologic models, Calibrations.

An examination of the calibration aspect of conceptual rainfall-runoff models was undertaken using the Sacramento soil moisture accounting

model and a study comparing the performance of a Newton-type optimization algorithm with that of a direct search algorithm. The primary finding is that the direct search algorithm was more likely than the Newton-type algorithm to find accurate parameter estimates, although the Newton-type used less computer time. The primary reason for the lack of robustness of the Newton-type algorithm appears to be poor conditioning of the response surface. Graphical studies of the response surface of the model's parameter space confirmed the presence of discontinuities and a rough-textured surface, particularly in the derivatives. Future research in this area should focus on the roles of model structure and calibration data in the optimization problem, and on methods to alleviate the problems of rough response surface texture, discontinuities, multiple optima, parameter interaction, and parameter nonidentifiability. (Author's abstract) abstract) W88-08662

HYDROLOGY PAST AND PRESENT, University Coll., Galway (Ireland). Dept. of Engineering Hydrology. J. C. I. Dodge. Journal of Hydraulic Research JHYRAF, Vol. 26, No. 1, p 5-26, 1988. 4 fig, 4 tab, 81 ref.

Descriptors: *Developing countries, *Human diseases, *Agriculture, *Theoretical analysis, Multi-disciplinary studies, Hydrology.

Scientific hydrology is considered against the background of the classical development of scientific knowledge. A possible candidate to be considered as the fundamental theorem in hydrology is ered as the fundamental theorem in hydrology is the concept contained in the equation of continuity. The application of statistical mechanics and system theory to the science of hydrology is reviewed. The relationship between hydrology and human problems is complex. Immediately related to the hydrological cycle are the cycle of erosion and sedimentation and the major biogeochemical cycles all of which interact with economic factors, such as urbanization and, social factors, such as population growth. The problem of supplying water for health and for food in developing countries and conditions and guidelines for effective solutions to these problems are considered. The future direction of hydrology, including the development of a unified hydrologic theory requires interaction of hydrologists specializing in the variations sub-divisions of the science. (Miller-PTT) W88-08953

2B. Precipitation

SULFUR, HALOGENS, AND HEAVY METALS IN SUMMER RAINS, CHURCHILL, MANITO-BA, CANADA, McMaster Univ., Hamilton (Ontario), Dept. of Ge-

For primary bibliographic entry see Field 5B. W88-08024

WETLAND BOUNDARY DETERMINATION IN THE GREAT DISMAL SWAMP USING WEIGHTED AVERAGES, Geological Survey, Reston, VA. For primary bibliographic entry see Field 2H. W88-88030

APPLICATION OF KRIGING TO ESTIMATING MEAN ANNUAL PRECIPITATION IN A REGION OF OROGRAPHIC INFLUENCE, New Hampshire Univ., Durham. Dept. of Earth

S. L. Dingman, D. M. Seely-Reynolds, and R. C.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 329-339, April 1988. 10 fig, 6 tab, 44 ref.

Descriptors: *Kriging, *Error analysis, *Alpine regions, *Orographic precipitation, Drainage systems, Model studies, Mathematical studies, Regional analysis, Stochastic process, Prediction, Rainfall, Equations, Vermont, New Hampshire, Estimating, Hydrologic budget.

Estimates of mean annual precipitation (MAP) over areas are the starting point for all computations of water and chemical balances for drainage basins and surface water bodies. Any errors in the estimates of MAP are propagated through the balance computations. These errors can be due to: (1) failures of individual gages to collect the amount of precipitation that actually falls; (2) operator errors; and (3) failure of the raingage network to adequately sample the region of interest. This paper attempts to evaluate the last of these types of error by applying kriging in two different approaches to estimating MAP in New Hampshire and Vermont, USA. The data base is the 1951-1980 normal precipitation at 120 raingages in the two states and in adjacent portions of bordering states and provinces. In the first approach, kriging is applied directly to the MAP values, while in the second, kriging applied to a 'precipitation delivery factor' that represents the MAP with the orographic effect removed. The first approach gives slightly better kriged estimates of MAP at seven validation stations that were not included in the original analysis, but results in an error surface that is highly contorted and in larger maximum errors over most of the region. The second approach had a considerably smoother error surface and, thus, is generally preferable as a basis for point and areal estimates of MAP at stimates in the region have 95 percent confidence intervals of about 20 cm/yr at low and moderate elevations, and up to 35 cm/yr at high elevations. These uncertainties amount to about 20 percent of estimated MAP values. (Author's abstract)

EFFECTS OF PRECIPITATION AND LAND USE ON STORM RUNOFF, Geological Survey, Lansing, MI. Water Resources

For primary bibliographic entry see Field 2E. W88-08050

FACTORS AFFECTING DEVELOPMENT OF HUFF CURVES,

Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed. J. V. Bonta, and A. R. Rao.

American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1689-1693, November-December 1987. 7 fig, 1 tab, 9 ref.

Descriptors: *Rainfall, *Storm hyetographs, *Huff curves, *Design storms, *Rainfall-runoff relation-ships, *Runoff, *Erosion, *Model studies, Correla-tion analysis, Sampling, Seasonal variation, Water chemistry, Weather.

Huff curves, which describe the variation in storm hyetographs, are sometimes used for design storms with models that provide estimates of runoff volume, peak flow, erosion, and water chemistry. However, factors that may affect the development of Huff curves have not been studied. Therefore, the effects of three factors that affect storm identifications. or rulir curves nave not been studied. Therefore, the effects of three factors that affect storm identification on Huff curves were investigated: sampling interval of precipitation data (3 and 60 min), method of identifying storms using the minimum (critical) dry-period duration between rainfall periods (rank correlation and exponential methods), and season of year. The effect of sampling interval on Huff curves is minor, allowing the use of more readily available hourly precipitation data by practicing engineers. The method of identifying individual storms using the critical duration of dry periods between rainfall periods also has a minor effect, in spite of large differences between critical duration estimates, making Huff curves relatively insensitive to estimates of critical duration. There is a significant effect of season of year on Huff curves Huff curves have potential for more wide-spread practical use as design storms. (Author's abstract)

PRECIPITATION CHARACTERISTICS FROM VARIABLE, HOURLY AND DAILY DATA BASES.

Missouri Water Resources Research Center, Co-

L. A. Kramer. American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1706-1712, November-December 1987. 2 fig, 2 tab, 8 ref.

Descriptors: *Rainfall, *Weather data collections, *Temporal distribution, *Statistical methods, *Model studies, Missouri, Frequency distribution, Variant coefficient, Skew coefficient, Design standards, Simulation, Prediction, Erosion.

A continuous 35-year detailed time-depth record of precipitation in central Missouri was used to develop variable, hourly and daily time bases of the same precipitation sequence. The three time bases were searched in turn for precipitation event periods according to a two parameter event definition. Events were identified by a minimum depth (0.25, 12.7 or 25.4 mm) and a minimum time without precipitation between events (6 h for variable and hourly time bases and 24 h for the daily time base data). Event characteristics of frequency, duration, interlude, depth, maximum 5-mm intensity, kinetic energy and erosivity were summarized for each time base at each level of minimum depth. Summary statistics showed high coefficients of variation and coefficients of skew for most event characteristics. Frequency distributions of the annual maximum series of the event characteristics were fitted by the method of moments to the log-Pearson III distribution. The event characteristics of duration, intentiled, depth and kinetic energy was similar. by the method of moments to the log-Pearson III distribution. The event characteristics of duration, interlude, depth and kinetic energy were similar for the variable and hourly time base data. The duration and depth characteristics were essentially identical. Thus, the hourly time base data may be adequate for certain design or simulation applications where these characteristics are important. However, characteristics of maximum 5-min intensity and erosivity were different for each time base and would be difficult to extrapolate from hourly and daily time base data when variable data are and daily time base data when variable data are unavailable. An estimating method is suggested to determine annual erosivity for variable time base data from hourly or daily data. (Author's abstract)

DOES EVAPORATION OVER THE ARABIAN SEA PLAY A CRUCIAL ROLE IN MOISTURE TRANSPORT ACROSS THE WEST COAST OF INDIA DURING AN ACTIVE MONSOON PERIOD.

National Inst. of Oceanography, Panaji (India). Y. Sadhuram, and M. R. R. Kumar. Monthly Weather Review MRWEAB, Vol. 116, No. 2, p 307-312, February 1988. 5 fig, 2 tab, 14

Descriptors: *Hydrologic cycle, *Hydrologic budget, *Atmospheric water, *Air circulation, *Marine climates, *Evaporation, *Precipitation, Rainfall, Wind, Monsoons, Coasts, Indian Ocean, Arabian Sea, Tropical regions, Southern Hemisphere, India, Meterological data collections, Water temperature, Dewpoint, Evaporation rate, Precipitation rate.

The Indian subcontinent receives about 70% of its annual rainfall during the summer monsconal winds; the moisture required could come from either the adjoining Arabian Sea or the Southern Hemisphere. In the present study interannual variability of the contributions of evaporation and moisture flux from the Southern Hemisphere towards ture in the moisture transport across the west coast of India is examined. Data on sea surface temperature, dewpoint temperature, and wind speed pertaining to the 1979 monsoon season were taken from the Indian Daily Weather Reports. The rates of the moisture and weight in the Indian Daily Weather Reports. of evaporation and precipitation over the Arabian Sea during the 1979 monsoon were found to bal-Sea during the 17/9 monsoon were tound to bai-ance each other; this suggests that the possible contribution from evaporation towards the mois-ture flux across the west coast of India is less significant. On a seasonal scale the ratio between cross-equatorial flux and the moisture transport across the west coast of India was dominant irrespective of the monsoon activity. Detailed infor-mation on evaporation and precipitation fields over the Arabian Sea under different phases of a mon-soon could help unravel the complexities regarding the moisture source. (Author's abstract)

W88-08116

PREDICTION OF THE 1979 SUMMER MON-

SOON ONSET WITH MODIFIED PARAME-TERIZATION SCHEMES, European Centre for Medium Range Weather Forceasts, Reading (England). J. A. Slingo, U. C. Mohanty, M. Tiedtke, and R. P.

Pearce. Monthly Weather Review MRWEAB, Vol. 116, No. 2, p 328-346, February 1988. 14 fig, 1 tab, 33

Descriptors: *Model studies, *Simulation, *Weather forecasting, *Winds, *Monsoons, *Mathematical models, European Centre for Medium-Range Weather Forecasts model, European Centre for Medium-Range Weather Forecasts, Hydrologic cycle, Air circulation, Radiation, Convection, Precipitation, Boundary layers, Return flow, Tropical regions, Indian Ocean, Arabian Sea, India.

The mechanism of the onset of the Asian summer monsoon, particularly the influence of large-scale flow features, is not well understood. With particular emphasis on the onset of the monsoon, this paper describes the impact of various changes in the treatment of physical processes upon tropical simulation in a weather-forecasting model. A series of 10-day forecasts was carried out, each integration starting from 12 noon Universal Time on 11 June 1979 and covering the rapid intensification of the monsoon over the Arabian Sea and Southern India. The model used was that of the European Centre for Medium-Range Weather Forecasts; the changes involved modifications to the radiation and Kuo penetrative convective schemes, and the introduction of a shallow convection, particular-fully the introduction of the shallow convection, particular-Changes to the dreament of convection, particular-ly the introduction of the shallow convection scheme, were found to have a large impact on tropical circulation and precipitation. In addition to an overall beneficial effect on the simulated large-scale flow (e.g., tradewinds and tradewind boundary-layer structure) there was a significant improvement of the monsoon simulation. It was found that only when the radiation changes were ed with the convection changes was there a combined with the convection changes was there a marked improvement in monsoon region simula-tion. The intensification of the low-level flow over the Arabian Sea was then much better represented as were the onset of the rains over Southern India and the establishment of the upper-level cross-equatorial return flow. (Author's abstract) W88-08117

GLOBAL ENERGY AND MOISTURE BUDG-ETS FROM RAWINSONDE DATA, Princeton Univ., NJ. Geophysical Fluid Dynamics

Program. H. I. Savijarvi. Monthly Weather Review MRWEAB, Vol. 116, No. 2, p 417-430, February 1988. 12 fig, 38 ref.

Descriptors: *Energy, *Hydrologic budget, *Mathematical analysis, *Estimating, Radiosondes, Meteorological data collections, Weather data collections, Weather foreasting, Climate, Air circulation, Winds, Convection, Evaporation, Precipitation tion, Temperate zone, Tropic zo

Recent years have brought about rapid developments in atmospheric data-assimilation methods and observing systems; however, the various assimilation-cycle climates may vary, even when based on the same input data. The purpose of the present study is to provide improved station data estimates from a dataset which has often been used as the reference climate. Verifically interest. sestimates from a dataset which has often been used as the reference climate. Vertically-integrated budgets of moisture and energy for the global atmosphere are presented, based on 10-year rawinsonde data analyses. The extratropical free-atmospheric mean wind divergence is derived from vorticity balance, and mass balance is imposed. The results of data so modified are shown in the form of winter and summer maps of mean vertical velocity, evaporation minus precipitation, mean diabatic heating, total energy flux divergence, and energy flux divergence potential. Also, the annual poleward energy transports are shown, together with the implied oceanic transports. The results

indicate that the procedure of getting divergent winds from vorticity balance works well at mid-latitudes and produces budgets comparable to esti-mates. The results for the tropics are free of any model assumptions-seuch as convection schemes (which may influence data-assimilation scheme climates, as is briefly discussed)-but are quite sensitive to the lack of data over oceans. (Author's abstract) W88-08118

IMPROVING PRECIPITATION FORECASTS FROM THE METEOROLOGICAL OFFICE FINE-MESH MODEL BY USING A MODIFIED EVAPORATION SCHEME.

Meteorological Office, Bracknell (England) O. M. Hammon, and C. A. Wilson. Meteorological Magazine MTMGA5, Vol. 117, No. 1386, p 21-25, January 1988. 2 fig, 4 ref.

Descriptors: *Weather forecasting, *Model studies, *Mathematical models, *Precipitation, *Evaporation, *Prediction, United Kingdom, Convective precipitation, Dynamic precipitation, Atmospheric pressure, Clouds, Air temperature.

During the last 3 years a significant number of fine-mesh model forecasts have underestimated the extent of showers over the United Kingdom, especially in northerly and north-westerly airstreams. It was felt that this behavior may have been due to It was telt that this behavior may have been due to excessive evaporation of convectively-produced rain. Therefore, a series of experiments was carried out to see if the precipitation forecasts could be improved by modifying the evaporation scheme which was being used in the operational model. The improved forecasts of precipitation, especially of showers, are illustrated. Forecast mean-sea-level or showers, are must need. To recess in many pressure is the same with both schemes. The modified scheme produces a significant increase in the number of light showers forecast over the sea; however, there are indications that showers over the sea may be too widespread with the modified version. There is a slight increase in the number of version. There is a slight increase in the number of light showers forecast over land with the modified scheme—of the eight cases in which the forecast of showers over land is important, the forecast distribution of showers is improved in six cases by using the modified scheme. There is a slight decrease in forecast amounts of low and medium cloud with the modified scheme; frontal clouds are mainly unaffected. The indications are that there is a switch from dynamic to convective rain with the switch from dynamic to convective rain with the modified scheme. When the model ascents from the two versions differ, those from the modified scheme are very slightly warmer and drier; in most cases the increase in temperature is only 0.1-0.2 degrees C. (Shidler-PTT) W88-08119

APPLICATION OF SUPERCOMPUTERS TO WEATHER FORECASTING, Meteorological Office, Bracknell (England).

K. M. Rogers.
Meteorological Magazine MTMGA5, Vol. 117,
No. 1388, p 65-78, March 1988. 3 fig, 3 tab, 13 ref.

Descriptors: *Model studies, *Meteorology, *Data processing, *Prediction, *Weather forecasting, *Computers, *Digital computers, CYBER 205 computer, CRAY X-MP computer, UK Meteorological Office, European Centre for Medium-Range Weather Forecasts, Mathematical studies, Numerical analysis, Prediction, Model studies, Computer models, Mathematical models.

The aim of this paper is to examine the architec-The aim of this paper is to examine the architectures of large conventional computers and of the new generation of supercomputers, in relation to using these designs in operational weather forecasting and other meteorological applications. The CYBER 205 and the CRAY X-MP range of computers are covered in more detail, since they are puters are covered in more detail, since they are the current operational computer systems at the UK Meteorological Office and at the European Centre for Medium-Range Weather Forecasts. It is clear that the accuracy of forecasts, achieved using predictive models, has progressed in stages with the available state-of-the-art computing power and this close liaison between numerical weather pre-

Group 2B-Precipitation

diction and supercomputers is likely to be impor-tant for the foreseeable future. (Author's abstract) W88-08120

PROGRESS IN THE DEVELOPMENT OF PAR-

Meteorological Office, Bracknell (England).

Meteorological Magazine MTMGA5, Vol. 117, No. 1388, p 79-86, March 1988. 4 fig, 7 ref.

Descriptors: *Data processing, *Data storage and retrieval, *Precipitation, *Rainfall, *Computers, *Digital computers, *Computer programs, *Meteorological data collection, *Weather data collections, *Radar, *Rain gages, Rainfall distribution, Rainfall intensity, Precipitation intensity, Mathematical analysis, Statistical analysis, United Kingdom Meteorological Office.

The United Kingdom Meteorological Office requires estimates of surface rainfall amount at ungaged locations for a range of periods from five minutes to one year. Quantitative measurements of rainfall from radar observations are now available. This paper describes PARAGON (Processing and Archiving of Radar and Gage data Off-line and in Near real-time)—a system developed in the Meteorological Office for the routine archiving and adjustment by gage observations of daily rainfall totals measured by radar. The basic rainfall intensities are measured virtually instantaneously by each radar every 5 minutes, accurately synchronized, ties are measured virtually instantaneously by each radar every 5 minutes, accurately synchronized, and given an automatic real-time on-site calibration using, as ground truth, observations from three to five dedicated gages within 75 km of each radar. The observations required for input into PARA-GON are hourly radar rainfall totals for each grid point as observed by each radar separately (single-site data), and obtained on-line or off-line. PARA-GON processing consists of a number of steps-including supplementary quality control, production of daily totals, compositing to eliminate coverage overlaps, adjustment by sparse and dense gage observations, and gage-only data fill-in in areas not yet covered or where data have been deleted. The yet covered or where data have been deleted. The system was planned to produce daily rainfall totals, system was planned to produce daily rainfall totals, with the computer software being developed in two phases—phase 1, off-line (non real-time) data and phase 2, on-line (real-time) data. The development of phase 1 is finished, but it now seems unlikely that phase 2 can be made operational before 1990 because of difficulties in transferring to the Meteorological Office central computer in real time the large amounts of single-site radar data involved. (Shidler-PTT) W88-08121

STRUCTURE OF A CONVERGENT CLOUD BAND OVER THE JAPAN SEA IN WINTER: A PREDICTION EXPERIMENT, Meteorological Research Inst., Yatabe (Japan).

M. Nagata.

Journal of the Meteorological Society of Japan
JMSJAU, Vol. 65, No. 6, p 871-883, December
1987. 23 fig, 19 ref.

Descriptors: "Monsoons, "Weather, "Weather forecasting, "Weather patterns, "Atmospheric physics," Clouds, "Cloud physics, "Precipitation, "Snow, "Mathematical models, Mathematical analysis, Mathematical equations, Prediction, Atmosphere, Air masses, Cloud cover, Japan Sea, Japan, Korea, Wind, Monsoons, Convection, Advection, Air circulation, Air temperature, Latent heat, Water vapor.

A 'convergent cloud band' that appears east of the Korean Peninsula over the western Japan Sea under northwesterly winter monsoon conditions often causes heavy snowfall in the Japanese Isoften causes neary snowrall in the Japanese is-lands. A prediction experiment was performed with a very-fine-mesh primitive equation model for a heavy snowfall event in the Hokuriku District associated with such a convergent cloud band. The results of the experiment, together with observed data, were used to elucidate the structure of the cloud band, which had a line of active convection on its continuestern edu. On the besis of excess on its southwestern edge. On the basis of cross-section and trajectory analyses, it was possible to make a clear picture of the surrounding atmos-

phere. There were (1) a low-level convergence and pnere. I here were (1) a low-level convergence and a middle-level divergence zone accompanied by intense positive vorticity along the line of active convection; (2) a warm weak-wind zone along the line of active convection embedded in the cold airmass; (3) a weak stable layer on the northeastern side of the line of active convection; (4) a westside of the line of active convection; (4) a westmorthwesterly air flow on the southwestern side of
the line of active convection with weak vertical
wind shear and nearly neutral stratification up to
the top of the cold airmass; and (5) a strong-wind
zone at the divergent level 300-500 km northeast of
the line of active convection. Heat and water
vapor analysis indicates that over the southern
Japan Sea the mesoscale thermal structure around
the cloud band is largely maintained by localized
release of latent heat in a large-scale cold air
advection field. (Author's abstract)
W88-08122 W88-08122

ESTIMATION OF ATMOSPHERIC LIQUID-WATER AMOUNT BY NIMBUS SMMR DATA: A NEW METHOD AND ITS APPLICATION TO THE WESTERN NORTH-PACIFIC REGION, Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 7B. W88-08123

NUMERICAL EXPERIMENTS OF THE CHARGING MECHANISM OF PRECIPITATION PARTICLES BY THE ION-CAPTURE PROCESS BELOW THE CLOUD BASE, Hokkaido Univ., Sapporo (Japan). Dept. of Geo-

Y. Asuma, and K. Kikuchi. Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 6, p 973-989, December 1987. 15 fig. 1 tab, 24 ref, append. Ministry of Education, Science and Culture of Japan Grant 51790129

Descriptors: *Precipitation, *Rainfall, *Rain, *Snow, *Electric charges, *Ion transport, *Cloud physics, Mathematical studies, Numerical analysis, Electrical properties, Polarity, Electric currents, Mirror-image relation.

Mirror-image relation.

In order to investigate the 'mirror-image relation' between the polarity of the electric charges on precipitation particles and that of the local potential gradient near the ground surface, a new formulation was derived in which snowflakes and snow particles acquire charges by the selective ion capture process. The mirror-image relation is more apparent during snowfall than during rainfall; charges on snow particles are also larger than those of raindrops in which the diameter is equivalent to the melted diameter of the snow particles. Although snowflakes have numerous pores, the final charges expected from selective ion capture are the same as those of a conductive sphere of the same diameter. It was expected therefore that the high porosity of snowflakes would lead to the increase of collection efficiency of ions and that a shorter time to attain their final charges would be required. The authors call this the 'penetration effect'. The formulation of a charging mechanism for snowflakes was derived. The modification of charges on precipitation particles under the cloud base was examined by one-dimensional numerical experiments. There was a tendency for ground-observed snowflakes to lose the electric charges produced in the cloud but for raindrops to keep the cloud-produced charges. The penetration effect was more apparent near the ground surface where produced in the cloud but for raindrops to keep the cloud-produced charges. The penetration effect was more apparent near the ground surface where ions are emitted abundantly into the atmosphere by point discharge. On the ground surface, precipitation current and point discharge current were balanced and this balanced relation brings about the mirror-image relation. (Author's abstract) W88-08124

KINEMATIC WAVE APPROXIMATION TO THE INITIATION OF SUBSURFACE STORM FLOW IN A SLOPING FOREST SOIL,

Virginia Univ., Charlottesville. Dept. of Environ-mental Sciences.

For primary bibliographic entry see Field 2G. W88-08180

SOUTH AFRICAN RAINFALL, THE SOUTH-ERN OSCILLATION AND A SOUTHERN HEMISPHERE SEMI-ANNUAL CYCLE,

University of the Witwatersrand, Johannes (South Africa). Climatology Research Group. J. A. Lindesay.

Journal of Climatology JOUCD2, Vol. 8, No. 1, p 17-30, January-February, 1988. 8 fig, 87 ref.

Descriptors: *South Africa, *Rainfall, *Climatology, *Seasonal variation, *Southern Oscillation, Distribution, Spatial distribution, Temporal distribution, Precipitation, Weather.

A plausible physical explanation is proposed for the observed relationship between the Southern Oscillation and rainfall over South Africa, based on Southern Oscillation-modulated variations in the frequency and location of cloud bands over the country. The greater importance of tropical influ-ences and the Southern Oscillation to South Afriences and the Southern Oscillation to South African rainfall variations later in the summer is consistent with apparent changes in the dynamics of the atmospheric circulation and the cloud bands over southern Africa on a semiannual cycle. Middle-latitude influences, which are not necessarily independent of the fluctuations of the Southern Oscillation, may dominate the circulation controls on rainfall in the early summer. While this suggestion has not been examined in detail, it is concluded that the role of the Southern Oscillation in modulating South African summer rainfall is significant, and that semiannual cycles in southern hemisphere circulation cannot be ignored when attempting to find circulation mechanisms to account for rainfall variations in southern Africa. (Doria-PTT) PTT) W88-08205

RELATIONSHIPS BETWEEN SEASONAL RAINFALL IN EAST AFRICA AND THE SOUTHERN OSCILLATION,

Nairobi Univ. (Kenya). Dept. of Meteorology. L. J. Ogallo.

Journal of Climatology JOUCD2, Vol. 8, No. 1, p 31-43, January-February, 1988. 11 fig, 1 tab, 24 ref.

Descriptors: *Seasonal variation, *Rainfall, *East Africa, *Southern Oscillation, *Climatology, Distribution, Correlation analysis, Monsoons, Wind,

Teleconnections between the Southern Oscillation and seasonal rainfall over East Africa during the period 1923-1984 were investigated using correlation methods. Results indicated significant negative zero lag correlations between Southern Oscillation and seasonal rainfall over parts of East Africa during the months of October-December. Maximum correlations were concentrated along the coast and over some western parts, although peak values in the range -0.6 were centered along central and northern coastal regions. During the months July-September, significant positive zero lag correlations in the range of 0.5 were observed over some western parts. Low zero lag correlations were, however, obtained over most of the regions with the January-May and annual rainfall records. The computed lagged correlation values displayed characteristics similar to those observed from the zero lag correlations. Highest month-to-month persistences were again centered within October/November when significant lag correlations. from the zero lag correlations. Highest month-to-month persistences were again centered within Oc-tober/November when significant lag correlations persisted for time lags greater than 2 months at some locations. Although there were some rela-tionships between the Southern Oscillation and seasonal rainfall over parts of East Africa, some of the extreme wet and dry episodes were not related to the Southern Oscillation. (Author's abstract) W88-08206

CHANGING RAINFALL PATTERNS IN WEST-ERN SUDAN,

United Nations Development Programme, Khartoum (Sudan). Sudan Early Warning System. E. Eldredge, S. E. S. Khalil, N. Nicholds, A. A. Abdalla, and D. Rydjeski.

Journal of Climatology JOUCD2, Vol. 8, No. 1, p 45-53, January-February, 1988. 8 fig, 2 tab, 11 ref.

Descriptors: *Rainfall distribution, *Temporal distribution, *Sudan, *Drought, *Climatology, *Rainfall intensity, Agriculture, Planning, Precipitation, Forecasting, Regression analysis, Model studies.

Rainfall series to 1986 have been examined for North Darfur and North Kordofan. Annual and Rainfall series to 1986 have been examined for North Darfur and North Kordofan. Annual and monthly series were analyzed. Relatively dry conditions have persisted in this region since 1966 due mainly to a decline in rainfall during July, August, and September, the critical months for the annual agricultural cycle. Changes in daily rainfall magnitude and frequency are examined for these four rainy season months. It is recommended that agricultural planning and government policies be based on recent meteorological patterns. It is concluded that the dry period either points to dryer times ahead, or is within expected, random variations from normal. In either case, the amounts of rain that can realistically be expected are significantly lower than what has been considered normal in the past. It is recommended that agricultural planning and government policies be based on recent meteorological patterns. Logical policy steps for semi-raid zones might include (1) changing cropping patterns to shorter growing season varieties; (2) easing grazing pressures on pastureland while shifting from cattle towards more drought-resistant animals; (3) reversing change towards settled agriculture in favor of nomadic cultural patterns; and (4) resettlement in more moisture-secure areas. (Author's abstract) resettlement in more moisture-secure areas. (Author's abstract) W88-08207

SPATIAL DISTRIBUTION OF PRE-WARM FRONT RAINFALL IN THE MEDITERRANE-AN AREA,

AN AREA,
Consiglio Nazionale delle Ricerche, Perugia
(Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.
C. Corradini, and F. Melone.
Nordic Hydrology NOHYBB, Vol. 19, No. 1, p
53-64, 1988. 7 fig, 2 tab, 16 ref.

Descriptors: *Hydrology, *Storms, *Rainfall, *Precipitation, Network design, Orography, Mountains, Air masses, Model studies, Parameterized numerical model, Parameteric Hydrology, Convection, Mountains, Mediterranean area.

Evidence is given of the distribution of pre-warm front rainfall at the meso-gamma scale, together with a discussion of the main mechanisms produc-ing this variability. An inland region in the Medi-terranean area is considered. The selected rainfall ing tins variability. An inflant region in the Mediterranean area is considered. The selected rainfall type is commonly considered the most regular inasmuch as it is usually unaffected by extended convective motions. Despite this, within a storm a large variability in space was observed. For 90% of measurements, the typical deviations from the area-average total depth ranged from -40 to 60% and the storm ensemble-average rainfall rate over a hilly zone was 60% greater than that in a contiguous low-land zone generally placed upwind. This variability is largely explained in terms of forced uplift of air mass over an envelope type corgraphy. For a few storms smaller orographic effects were found in locations influenced by an orography with higher slopes and elevations. This feature is ascribed to the compact structure of these mountains which probably determines a deflection of air mass in the boundary layer. The importance of this type of analysis in the hydrological practice is also emphasized. (Author's abstract) W88-08294

NEGLECTED WATER RESOURCE: THE CA-MANCHACA OF SOUTH AMERICA, Atmospheric Environment Service, Downsview (Ontario).

For primary bibliographic entry see Field 3B. W88-08319

HUNTER REGION (AUSTRALIA) ACID RAIN PROJECT.

Newcastle Univ. (Australia). Dept. of Geography. For primary bibliographic entry see Field 5B. W88-08320

THUNDERSTORM-PRODUCING TERRAIN

Air Force Geophysics Lab., Hanscom AFB, MA. C. B. Schaaf, J. Wurman, and R. M. Banta. Bulletin of the American Meteorological Society BAMIAT, Vol 69, No. 3, p 272-277, March 1988. 2 fig, 19 ref.

Descriptors: *Meteorology, *Climatology, *Precipitation, *Terrain analysis, *Thunderstorms, Weather, Storms, Mountains, Satellite technology, Colorado, New Mexico.

Thunderstorms were traced back to their initiation sites to determine areas of repeated thunderstorm genesis over the Sangre de Cristo Mountains of Colorado and New Mexico. Using three summers of geosynchronous satellite data it was found that genesis-zone activity depended on the direction of the winds above the ridgetops, indicating upper-level wind direction to be a likely 'necessary' (but not 'sufficient') predictor of the location of mountain-thunderstorm initiation. Some individual topographic features associated with each genesis zone can be identified. (Author's abstract)

PROPOSED TROPICAL RAINFALL MEASURING MISSION (TRMM) SATELLITE,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. For primary bibliographic entry see Field 7B. W88-08322

CHLORIDE IN PRECIPITATION AND STREAMWATER FOR THE UPLAND CATCH-MENT OF RIVER SEVERN, MID-WALES: SOME CONSEQUENCES FOR HYDROCHE-MICAL MODELS, Lestitute of Hydrology, Wallingford (England)

Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2K. W88-08369

PREDICTION OF ANNUAL RAINFALL AT FORTALEZA, CE, BRAZIL IN RECENT

Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). R. P. Kane

R. P. Kane. Available from the National Technical Information Service, Springfield, VA 22161, as N87-28226. Price codes: A03 in paper copy, A01 in microfiche. April 1987. 24 p, 6 fig, 3 tab, 14 ref. Fundo Nacional de Desenvolviment to Científico e Tec-nologico Contract FINEP 537/CT.

Descriptors: *Rainfall forecasting, *Weather data collections, *Brazil, *Data interpretation, *Statistical analysis, Rainfall intensity, Forecasting, Future planning, Drought, Flortaleza.

Power Spectrum Analysis of Fortaleza annual rainfall data for 1849-1976 indicated periodicities T = 12.9 and 25.1 years significant at a 5-sigma (a priori) level and in addition, T = 2.07, 3.63, 4.84, 5.69, 10.1, 18.0, and 61.0 at a 2-sigma (a priori) level. Using all these, the predicted values for 1977-86 matched well with the observed values. In the future, a minor drought during 1993-96 and a major drought during 2003-12 are envisaged. However, the above periodicities explain only about a 62% variance, implying a 38% random component. The standard errors for predicted flood and drought rainfalls are sigma = + or - 400 mm and sigma = + or - 300 mm, respectively. Therefore, drought intervals could have a few years of normal or even above normal) rainfalls. Similarly, droughts could occur during expected flood intervals. A transient QBO (T = 2-3 years) could complicate matters further. (Author's abstract) W88-08412

CHEMISTRY OF ACID RAIN: SOURCES AND ATMOSPHERIC PROCESSES,

Allied-Signal, Inc., Des Plaines, IL. Engineered Materials Research Center. For primary bibliographic entry see Field 5B. W88-08442

DECADE OF ACID RAIN RESEARCH,

Maryland Univ., College Park. Dept. of Chemis-For primary bibliographic entry see Field 5B. W88-08443

SUBCONTINENTAL AIR POLLUTION PHENOMENA,

Nevada Univ. System, Reno. Desert Research Inst. For primary bibliographic entry see Field 5B. W88-08444

ACID DEPOSITION AND ATMOSPHERIC CHEMISTRY AT ALLEGHENY MOUNTAIN, Ford Motor Co., Dearborn, Ml. Research Staff. For primary bibliographic entry see Field 5B. W88-08445

WESTERN ATLANTIC OCEAN EXPERIMENT, Virginia Univ., Charlottesville. Dept. of Environ-mental Sciences. For primary bibliographic entry see Field 5B. W88-08446

SO2 OXIDATION BY HYDROGEN PEROXIDE IN SUSPENDED DROPLETS,

Frankfurt Univ. (Germany, F.R.). Inst. fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 5B.
W88-08454

MEASUREMENT OF CONCENTRATION AND OXIDATION RATE OF S(IV) IN RAINWATER IN YOKOHAMA, JAPAN,

Keio Univ., Yokohama (Japan). Dept. of Applied Chemistry. For primary bibliographic entry see Field 5B. W88-08455

RAINWATER CHEMISTRY NEAR AN ISO-LATED SO2 EMISSION SOURCE, Washington Univ., Seattle. Dept. of Civil Engi-

For primary bibliographic entry see Field 5B. W88-08459 neering.

SULFUR, HALOGENS, AND HEAVY METALS IN URBAN SUMMER RAINFALL, McMaster Univ., Hamilton (Ontario). For primary bibliographic entry see Field 5B. W88-08460

INTRODUCTION OF FORMATE AND ACE-TATE IONS INTO PRECIPITATION: ASSESS-MENT OF POSSIBLE PATHWAYS, Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 2K. W38-08461

COMPARISON OF WEEKLY AND DAILY WET DEPOSITION SAMPLING RESULTS, Environmental Monitoring and Services, Inc., Ca-For primary bibliographic entry see Field 5B. W88-08462

CHEMISTRY OF WINTERTIME WET DEPO-General Motors Research Labs., Warren, MI. En-

vironmental Science Dept.
For primary bibliographic entry see Field 5B.
W88-08463

DEPOSITION OF CHEMICAL COMPONENTS IN JAPAN, Meteorological Research Inst., Yatabe (Japan).

For primary bibliographic entry see Field 5B. W88-08465

ACID CLUSTERS.

Group 2B—Precipitation

nsylvania State Univ., University Park. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W88-08469

METEOROLOGICAL MONITORING WITH European Space Operations Centre, Darmstadt (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W88-08471

ACID RAIN: CHEMISTRY AND TRANSPORT, Warren Spring Lab., Stevenage (England). For primary bibliographic entry see Field 5B. W88-08561

WORMS AND WATER, Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. For primary bibliographic entry see Field 2G. W88-08620

NUTRIENT CONTROL IN THROUGHFALL WATERS OF FOREST ECOSYSTEMS. Polish Academy of Sciences, Lomianki. Inst. Ekologii.

For primary bibliographic entry see Field 21. W88-08840

GROWTH RESPONSES OF BIRCH AND SITKA SPRUCE EXPOSED TO ACIDIFIED RAIN.

Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 5C.
W85-08893

SEASONAL AND INTRASEASONAL CLIMA-TOLOGY OF SUMMER MONSOON RAIN-FALL OVER EAST ASIA, National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. K. M. Lau, G. J. Yang, and S. H. Shen. Monthly Weather Review MRWEAB, Vol. 116, No. 1, p 18-37, January 1988. 17 fig, 26 ref. NSF Grant ATM-8414834.

Descriptors: *Climatology, *Monsoons, *Precipitation, *Rainfall, Seasonal variation, *Excess rainfall, *East Asia, China, India, Meteorology, Satellite technology, Climate dynamics, Longwave ra-diation, Polar front, Mei-yu, Plum rain.

Climatology of 30-day and 10-day rainfall records Commission of so-day and robay raintain records from East Asian stations were studied and compared with satellite ongoing longwave radiation and the large-scale circulation field. Results show that climatologically two major monsoon rainfall onsets over East Asia are identified during the period from April to September. The first, known so the Meisun for plumptish per the state of the period from April to September. The first, known as the Mei-yu (or plum rain), occurs over central China around the beginning or the middle of June, and the second over northeast China during late July. The multiple onsets occur as the major rain-bands make rapid transitions or sudden jumps be-tween three somewhat stationary positions over southern China (pre-monsoon rain), central China southern China (pre-inoissout rain), centra China (the Mei-yu front) and northeastern China (the polar front). Also found are the presence of 40-day oscillations in the rainfall climatology. Both oscillations exhibit structure and propagation consistent with previous studies. Abrupt changes by the major rainbands appear to be related to absess lockier between interpresental ceitiful. changes by the major ramoands appear to be retar-ed to phase-locking between intraseasonal oscilla-tions, such as the 40-day mode and the 20-day mode, and the seasonal variation. A comparison of the rainfall climatology with that over India is also discussed. (Author's abstract) W88-08942

SYNOPTIC-SCALE MODULATION OF COM VECTION DURING SUMMER MONSOON, THE AUSTRALIAN Bureau of Meteorology, Melbourne (Australia). T. D. Keenan, and L. R. Brody.

Monthly Weather Review MRWEAB, Vol. 116, No. 1, p 71-85, January 1988. 6 fig, 1 tab, 26 ref.

Descriptors: *Infrared Imagery, *Monsoons, *Australia, *Satellite technology, *Precipitation, *Convective precipitation, *Rainfall, *Tropic zone, *Subtropic zone, *Wind, *Convection, Japanese, Geostationary Meteorology Satellite, Synopticscale bands, Trade winds, Tropospheric troughs, Subtropical jet streaks, Monsoonal convection, Temperature.

Time-longitude representations of Japanese Geo-stationary Meteorology Satellite (GMS) infrared imagery indicate the existence of major synoptic-scale banding within the Australian summer mon-soon. The bands can be interpreted as active and beach phase of major convective activity within break phases of major convective activity within the monsoon. This study relates the occurrence of the monsoon. In its study retailes the occurrence or convection and its organization into synoptic-scale bands to observable flow features. GMS Digital Equivalent Blackbody Temperature (T sub BB) data and wind fields from the Australian Numerical Meteorology Research Centre (ANMRC) tropical analysis scheme for the 1983/84 seasons were composited relative to wind field surges and bands of phase-order and surgested and s of enhanced and suppressed convective activity. Some low-level wind surges in the South China Sea produced a modulation in the convective ac-tivity within the preexisting bands but did not seem to be associated with their formation. Surges in the to be associated with their formation. Surges in the Southern Hemisphere trade-wind easterlies and the southerly jet off the west coast of Australia were not associated with any major change in convective activity. The organization of the convection into synoptic-scale bands was associated with the Southern Hemisphere 200 mb flow. Areas of enhanced convective banding were east of upper-level tropospheric troughs. The troughs and associated subtropical jet streaks had amplified from the south, interacting and enhancing the monstonal convection. West of the trough, in the region of subsiding air, the convection was suppressed, independent studies taken from the 1984/85 season showed that this type of interaction was discernable for individual cases. (Author's abstract) W88-08943

THERMAL BUDGET OF A MONSOON DE-PRESSION IN THE BAY OF BENGAL DURING FGGE-MONEX 1979,

K. Saha, and S. Saha. Monthly Weather Review MRWEAB, Vol. 116, No. 1, p 242-254, January 1988. 10 fig, 2 tab, 16 ref.

Descriptors: *Monsoons, *Wind, *Bay of Bengal, *Precipitation, *Rainfall, *Energy, *Thermo dynamics, *Air circulation, *Subsidence, Meteorology, Thermal budget, Diabatic heating, Monsoon depression, Climatology, India, Adiabatic warming, Thermodynamic energy equation.

The paper presents the results of a study of the thermal budget of a monsoon depression that developed over the Bay of Bengal during the period of time from July 3 to July 8, 1979. The complete of time from July 3 to July 8, 1979. The complete thermodynamic energy equation is considered, to examine the possible role of the various terms and to evaluate the total diabatic heating. In the west-southwest quadrant of the monsoon depression where there is considerable rainfall, latent heat by precipitation appears to account for about 80% of the total diabatic heating, this heating appears to be offset by cooling due to strong upward motion; however, the total diabatic heating over and area immediately to the north-northeast of the depression center appears to be negative, suggesting downward air motion and adiabatic warming. It is suggested that this warm sector to the north-north-ast of the depression center, which is maintained east of the depression center, which is maintained by subsidence warming, may serve as an effective tropospheric energy source for the monsoon de-pression. (Author's abstract) W88-08944

PREDICTIVE MONSOON SIGNAL IN THE SURFACE LEVEL THERMAL FIELD OVER INDIA, Maryland Univ., College Park. Dept. of Meteorol-

ogy. D. A. Mooley, and D. A. Paolino.

Monthly Weather Review MRWEAB, Vol. 116, No. 1, p 256-264, January 1988. 5 fig. 3 tab, 25 ref. NSF Grant ATM-8414660 and NASA Global Weather Program (NASA-NAGW-558).

Descriptors: *Statistical analysis, *Monsoons, *Wind, *Prediction, *Precipitation, *Rainfall, *Imperature, *Weather forecasting, *India, Linear correlation analysis, Climatology, May minimum temperature, Prediction, Seasonal variation, Minimum temperature, Southern oscillation index, Sea surface temperature, Meteorology.

This is primarily a statistical study based on linear correlation analysis. The mean monthly surface thermal field over India based on a fairly well-distributed network of 119 stations has been examined for March-May during the period 1901-75 for the relationship with rainfall during the following monsoon season. The study brings out three areas (the first and the third from the central portion of westers India the second from southern periosular monsoon season. The study brings out three areas (the first and the third from the central portion of western India, the second from southern peninsular India) for which the relationships between area average of mean monthly minimum temperature for April (for the first and second areas) or for May (for the third area), and Indian monsoon rainfall are stable and consistently significant for 20-30 year periods after 1940. The best of these relationships is that with the May minimum temperature over the third area, significant at the 0.1% level. The relationships with mean April minimum temperature over the third area is significant at the 5% level. The mean May minimum temperature over the third area is significantly related to the 500 mb April ridge, tendency in Southern OScillation Index (SOI), and the tendency in eastern equatorial Pacific sea surface temperature. In combination with the ridge, the mean minimum May temperature gives forecasts of Indian monsoon rainfall which are as good as those given by tendency in SOI in combination with the ridge. The parameters SOI tendency and May minimum temperature are found to be equally useful. (Author's abstract) W88-08945

NUCLEATION OF SULFURIC ACID-WATER AND METHANESULFONIC ACID-WATER SOLUTION PARTICLES: IMPLICATIONS FOR ATMOSPHERIC CHEMISTRY OF ORGANO-SULFUR SPECIES, California Inst. of Tech., Pasadena. Dept. of

Chemical Engineering.
For primary bibliographic entry see Field 5B.
W88-08946

NUMERICAL STUDIES OF ACIDIFICATION PROCESSES WITHIN AND BELOW CLOUDS WITH A FLOW-THROUGH CHEMICAL REAC-

Argonne National Lab., IL. Environmental Research Div. For primary bibliographic entry see Field 5B. W88-08947

TIME-TRENDS OF SULFATE AND NITRATE IN PRECIPITATION IN NORWAY (1972-1982), Bergen Univ. (Norway). Geofysisk Inst. For primary bibliographic entry see Field 5B.

ACID RAIN IN SOUTHWESTERN CHINA, Academia Sinica, Beijing (China). For primary bibliographic entry see Field 5B. W88_08040

SOLUBILITY OF SOME NATURAL MINERALS IN ATMOSPHERIC PRECIPITATION, Arizona Univ., Tucson. Inst. of Atmospheric Phys-For primary bibliographic entry see Field 2K. W88-08951

POSSIBLE ROLE OF THE BIOSPHERE IN THE CONTROL OF ATMOSPHERIC CLOUDS AND PRECIPITATION,

Snow, Ice, and Frost-Group 2C

Institute for Atmospheric Physics, Budapest (Hungary). E. Meszaros.

Atmospheric Chemistry ATENBP, Vol. 22, No. 2, p 423-424, February 1988. 10 ref.

Descriptors: "Precipitation, "Clouds, "Sulfates, *Albedo, "Air-earth interfaces, "Atmosphere, "Chemistry of precipitation, Cloud condensation nuclei, Biosphere.

The role of the biosphere as a major determining factor in the control of present conditions on earth is briefly examined. It is well documented that atmospheric sulfate particles constitute the major class of cloud condensation nuclei. Under natural conditions, not disturbed by human activities, sulfate particles form from gaseous precursors released by the biosphere. In this way the biosphere plays an important role in the control of the cloud conver and consequently of the albedo of the earth-atmosphere system. On the other hand, cloud condensation nuclei of biospheric origin make the redistribution of water on the earth surface possible which is of crucial importance for the existence of living species. (Miller-PTT) W88-08952

SIMILARITY BETWEEN SIZE SPECTRA OF FOG DROPLETS AND SIZE SPECTRA OF DROPLETS INDUCED IN AN ISOTHERMAL CLOUD CHAMBER BY THE ATMOSPHERIC AEROSOL BEFORE FOG FORMATION: POSSIBILITY OF PREDICTING MICROPHYSICAL FEATURES OF FOG (SIMILITUDES DES SPECTRES DIMENSIONNELS, D'UNE PART, DES GOUTTELLETTES INDUITES EN CHAMBRE A BROUILLARD PAR L'AIR ATMOSPHERIQUE AVANT LE BROUILLARD: POSSIBILITE DE PREVOIR LES CHARACTERISTIQUES DU BROUILLARD), Observatoire de Physique du Globe de Clermont-Ferrand (France).

Ferrand (France).
For primary bibliographic entry see Field 2K.
W88-08958

2C. Snow, Ice, and Frost

COMPONENTS OF THE SURFACE RADI-ATION BALANCE OF SUBARCTIC WETLAND TERRAIN UNITS DURING THE SNOW-FREE SEASON McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography.
For primary bibliographic entry see Field 2E.
W88-08023

HYDROLOGY OF ALASKAN WETLANDS, U.S.A.: A REVIEW, Cornell Univ., Ithaca, NY. Ecosystems Research

Center. For primary bibliographic entry see Field 2H. W88-08025

SLUSHFLOWS IN A SUBARCTIC ENVIRON-MENT, KILPISJARVI, FINNISH LAPLAND, Southampton Univ. (England). M. J. Clark, and M. Seppala. Arctic and Alpine Research ATLPAV, Vol. 20, No. 1, p 97-105, February 1988. 7 fig, 2 tab, 30 ref.

Descriptors: *Slush *Slushflows, *Avalanches, *Sediment transport, *Subarctic zone, Snow, Lapland, Finland.

Slushflows are a potentially significant hydrological and sediment transport mechanism in the nival zone. They have previously been studied mainly in the context of wet snow avalanches within gullies the context of wet snow avalanches within gullies on the steep slopes of mountain areas, but valley-bottom flows in non-alpine areas of the arctic and subarctic may have been underestimated. Evidence of the repeated occurrence of such slushflows in the Kilpisjarvi region, Finnish Lapland, is present-ed. Field diagnosis is stressed, since it may be that the underestimation of this important though low-

frequency sediment transport process has been a result of failure to recognize its characteristic at-tributes in nonalpine situations. (Author's abstract)

IMPORTANCE OF HYDROGEN IONS AND ALUMINUM IN REGULATING THE STRUC-TURE AND FUNCTION OF STREAM ECOSYS-TEMS: AN EXPERIMENTAL TEST,

Ontario Ministry of the Environment, Dorchester. Dorset Research Center. For primary bibliographic entry see Field 5C. W88-08093

SOLAR HEATING AND ITS INFLUENCE ON MIXING IN ICE-COVERED LAKES, Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics. For primary bibliographic entry see Field 2H. W88-08100

STABLE GROWTH OF SEGREGATED ICE IN FREEZING SOIL UNDER NEGLIGIBLE OVERBURDEN PRESSURE, Cold Regions Research and Engineering Lab., Hanover, NH., Y. Nakano.

Advances in Water Resources AWREDI, Vol. 9, No. 4, p 223-235, December 1986. 1 fig, 1 tab, 10

Descriptors: *Soil temperature, *Freezing, *Ground ice, *Ice pressure, *Mathematical models, *Frost heaving, Overburden, Segregated ice, Ice formation, Saturated soil.

The stable growth condition of a segregated ice layer was studied using the principle of mass and heat conservation. This condition evidently deneat conservation. Inis condition evidently de-pends upon the properties of a thin transitional zone, which is believed to exist between the boundary of an ice layer and 0 Celsius isotherm. All probable models of the transitional zone are classified and the conditions for each model is derived. The effect of the small amount of soil minerals contained in an ice layer was also studied.
(Author's abstract) W88_08190

BEHAVIOUR AND TRANSPORT OF OIL UNDER SMOOTH ICE, Waterloo Univ. (Ontario). Dept. of Civil Engineer-

ary bibliographic entry see Field 5B. W88-08209

THERMAL PRESSURE DUE TO AN ICE CAP IN AN ELEVATED WATER TANK, Queen's Univ., Kingston (Ontario). Dept. of Civil

Engineering. W. L. Kong, and T. I. Campbell. Canadian Journal of Civil Engineering CJCEB8, Vol. 14, No. 4, p 519-526, August, 1987. 10 fig, 10

Descriptors: *Water tanks, *Ice cover, *Thermal stress, *Deterioration, *Mathematical models, Stress, Rheology, Concretes, Model studies, Temperature, Prediction, Model testing, Creep.

Pressures exerted by an ice cap contained within a circular tank and subjected to an increase in tem-perature were studied, since ice formations have contributed to the deterioration observed in elevat-ed reinforced concrete water tanks in Ontario. It was shown that the distributions of hoop and flex-ural stresses in the wall are similar to those induced by a band of linearly varying pressure around the circumference. Idealized distributions of hoop and flexural stresses were proposed and charts present-ed for determining peak hoop and flexural stresses in the wall. A mathematical model for ice was validated by data from tests on a model steel water tank containing an ice cap and was used to develop charts suitable for estimating the reduction in peak stresses due to creep of the ice. (Doria-PTT) W88-08710

SUBGLACIAL HYDROLOGY FOR AN ICE SHEET RESTING ON A DEFORMABLE AQUI-

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Mathematics and Statistics. F. M. Shoemaker.

Journal of Glaciology JOGLAO, Vol. 32, No. 110, p 20-30, 1986. 4 fig. 5 tab, 39 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Ice sheets, *Aquifers, *Glacial aquifers, *Glacial streams, *Snowmelt, *Drainage systems, Theoretical analysis, Aquitards, Soil water, Deformation.

Subglacial hydrology is investigated for an ice sheet where the substrate consists of a deformable aquifer resting on an aquitard. If sliding velocities are low or absent, subglacial melt-water drainage is are low or absent, subglacial melt-water drainage is dominated by drainage through the aquifer to water channels. Drainage along the bed is negligible. Efficient melt-water drainage requires that a system of subglacial water channels exists; otherwise, pore-water pressures will exceed the overburden pressure. In general, aquifer deformation near (away from) the terminus is most likely to occur during the winter (summer). The effect of short-term high channel pressures is, in general, not critical to aquifer deformation because the pressure pulse does not propagate far into the aquifer. (For aquifers of high permeability, short periods of high channel pressures constitute the most critical condition). Aquifer deformation at the terminus is very likely to occur if the terminus ice nost critical continon. Aquier detromation at the terminus is very likely to occur if the terminus ice slope exceeds tan phi, where phi is the Coulomb friction angle of the aquifer material. Upwelling of basal melt water near the terminus will normally cause soil dilation if the aquifer has a low perme-ability (e.g. till). Maximal profiles are computed corresponding to various aquifer materials using channel spacings which provide efficient drainage. (Sand-PTT)

MELT-WATER DRAINAGE PATTERN OF COMPOSITE GLACIERS,

Geologisches Landesamt Krefeld (Germany, F.R.). Nordrhein-Westfalen,

Journal of Glaciology JOGLAO, Vol. 32, No. 110, p 95-100, 1986. 5 fig, 11 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Drainage systems, *Snowmelt, *Moraines, *Glaciation, *Paleohydrology, Iceland, Waterways, Dams, Icedammed lakes, Ice sheets.

Medial moraines and lineations on the surface of composite glaciers enable the detection of structur-al and hydrological features. A study of the com-posite glacier Breidamerkurjokull, south Iceland, indicates relationships between unbulk indicated indicates relationships. posite garcier brenameratiforam, south teenand, indicates relationships between subglacial water-ways, ice structure in the junction area, and devel-opment of the glacier terminus. Rivers are situated in or near medial moraines because melt water in or near median moraines occasio mela water percolates to the bed and moves from there with the subglacial rivers mainly in the direction of ice flow. The contact between two feeder glaciers sometimes forms an angle at the glacier terminus. Then the melt-water river escaping from the con-tact, generally in a radial direction (away from the glacier front), during the retreat will be transferred to the front of the first receding glacier. The drainage of the contact zone then changes from a radial to a tangential direction, destroying the terminal moraines of the recession stages. Similar relations are found in relics of Pleistocene sheets, two examples of which are compared. The huge subglacial channel of the Munsterlander Kiessandzug-Esker below the ice sheet of the Saalian glacia-20g-Esser below the se suice to the same parties into in the Munsterland, north-west Germany, was formed in the ice-flow direction. It therefore gives details of the morphology and of the great ice-dammed lake east of the Teutoburger Wald ridge. dammed lake east of the Teutoburger Wald ridge.
At the contact between the Norwegian and Baltic Seas glaciers, the terminus formed an angle during the maximum extent of the Weichselian glaciation in northern Jutland. During retreat, the Norwegian glacier receded first. The large melt-water river escaping from the contact between both glaciers had formed the huge Karup Sandur during the maximum, but now, during the recession, it

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changed to the front of the Norwegian ice, destroying the recession moraines there. (Author's WRS-08234

COMBINED MEASUREMENTS OF SUBGLA COMBINED MEASUREMENTS OF SUBGLA-CIAL WATER PRESSURE AND SURFACE VE-LOCITY OF FINDELENGLETSCHER, SWIT-ZERLAND: CONCLUSIONS ABOUT DRAIN-AGE SYSTEM AND SLIDING MECHANISM, Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.

rsydrotogie und Giaziologie. A. Iken, and R. A. Bindschadler. Journal of Glaciology JOGLAO, Vol. 32, No. 110, p 101-119, 1986. 15 fig. 2 tab, 46 ref. 3 append. ETH Research Commission grant Reg. Nr. 12752/ 41-02 30.5.

Descriptors: *Glaciers, *Glaciohydrology, *Water pressure, *Surface velocity, *Drainage systems, Snowmelt, Water pressure, Channels, Velocity, Theoretical analysis, Switzerland.

During the snow-melt season of 1982, basal water pressure was recorded at 11 bore holes communicating with the subglacial drainage system. In most of these holes the water levels were at approximately the same depth (around 70 m below surface). The large variations of water pressure, e.g. diurnal variations, were usually similar at different locations and in phase. In two instances of exceptionally high water pressure however systematic itionally high water pressure, however, systematic phase shifts were observed; a wave of high pressure travelled down-glacier with a velocity of 100 m/b. The glacier-surface velocity was measured at 4 lines of stakes several times daily. The velocity variations correlated with variations in subglacial variations for the proposed properties of the proposed participations of the proposed participations. variations correlated with variations in subglacial water pressure. The functional relationships of water pressure and velocity suggests that fluctuating bed separation was responsible for the velocity variations. The empirical functional relationship is compared to that of sliding over a perfectly lubricated sinusoidal bed. On the basis of the measured velocity-pressure relationship, this model predicts a reasonable value of bed roughness but too high a sliding velocity and unstable sliding at too low a water pressure. The main reason for this disagreement is probably the neglect of friction from debris in the sliding model. The measured water pressure was considerably higher than that predicted by the theory of steady flow through straight cylindrical theory of steady flow through straight cylindrical channels near the glacier bed. Possible reasons are considered. The very large disagreement between measured and predicted pressure suggests that no straight cylindrical channels may have existed. (Author's abstract) W88-08235

DISCHARGES OF TURBID WATER DURING MINI-SURGES OF VARIEGATED GLACIER,

ALASKA, U.S.A., Washington Univ., Seattle. Geophysics Program. For primary bibliographic entry see Field 2F. W88-08236

SOME OBSERVATIONS ON SUBGLACIAL GROUND-WATER FLOW, University of Western Ontario, London. Dept. of Geography. For primary bibliographic entry see Field 2F. W88-08237

SNOWFALL AND OXYGEN-ISOTOPE VARI-

SNOWFALL AND OXYGEN-ISUTUPE VARIATIONS OFF THE NORTH COAST OF ELLES-MERE ISLAND, N.W.T., CANADA, Alaska Univ., Fairbanks. Geophysical Inst. M. O. Jeffries, and H. R. Krouse. Journal of Glaciology JOGLAO, Vol. 33, No. 114, p 195-199, 1987. 4 fig. 2 tab, 14 ref.

Descriptors: *Ice shelves, *Ice cover, *Snow depth, *Snow accumulation, Oxygen isotopes, Seasonal variation, Temperature, Precipitation, Ellesmere, Island, Canada, Isotope studies, Frequency distribution, Hoar frost

Snow-pack along the land-fast fringe off the north coast of Ellesmere Island was generally character-

ized by depth-hoar overlain by dense snow and wind slab. Mean snow depth in the study area was 0.54 m (1982-85) and the mean delta-oxygen-18 value of the snow-pack was -31.3 per thousand. Isotope data were not obtained previously for this geographic region and, therefore complement a previous study of delta-oxygen-18 variations in High Arctic snow. The data are consistent with an Arctic Ocean moisture source. The delta-oxygen-18 varies show seasonal variations, with winter Arctic Ocean moisture source. The delta-oxygen-18 profiles show seasonal variations, with winter snow being more depleted in oxygen-18 than fall and spring snow. However, the delta-oxygen-18 profiles are dominated by a trend to higher values with increasing depth. This is attributed to a dewith increasing depth. This is attributed to a decrease in delta-oxygen-18 values as condensation temperatures fall during the autumn-winter accumulation period. During this time, there is also a change from relatively open to almost complete ice cover in the Arctic Ocean. The change in evaporation conditions and consequent effect on delta values gives rise to a sharp discontinuity in the delta-oxygen-18 profiles and a bi-modal delta-oxygen-18 frequency distribution. The bi-modal distribution is reinforced by a secondary isotope fractionation that occurs during depth-hoar formation. This isotope effect leads to a wider delta-oxygen-18 range but does not significantly alter the mean value. (Author's abstract)

SNOWPACK ION ACCUMULATION AND LOSS IN A BASIN DRAINING TO LAKE SUPE-RIOR,

Michigan Technological Univ., Houghton. Dept. of Biological Sciences. For primary bibliographic entry see Field 2K. W88-08265

SNOWMELT RUNOFF IN SUBURBAN ENVI-RONMENTS. Trent Univ., Peterborough (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W88-08292

TRANSPORT OF WATER IN FROZEN SOIL: VI. EFFECTS OF TEMPERATURE, Cold Regions Research and Engineering Lab., Hanover, NH.

For primary bibliographic entry see Field 2G. W88-08339

EMBANKMENT DAMS ON PERMAFROST: DESIGN AND PERFORMANCE SUMMARY, BIBLIOGRAPHY, AND AN ANNOTATED BIB-LIOGRAPHY,

Cold Regions Research and Engineering Lab., Hanover, NH. For primary bibliographic entry see Field 8A. W88-08429

MONITORING OF SNOW COVER FROM SAT-

Helsinki Univ. of Technology, Espoo (Finland). For primary bibliographic entry see Field 7B. W88-08472

SNOW-MAPPING IN WESTERN GREEN-LAND.

LAND, Copenhagen Univ. (Denmark). Inst. of Geography. H. Sogaard. IN: Europe from Space. Proceedings of an ESA/ EARSeL Symposium held in Conjunction with EARSeL's General Assembly at the Technical University of Denmark, Lyngby, June 25-27, 1986. Report No. SP-258, December 1986. p 245-249, 6 fig, 2 tab, 7 ref.

Descriptors: *Snow cover, *Maps, *Data interpretation, Satellite technology, Remote sensing, Hydrologic budget, Hydrologic models, Computers, Model studies, Image processing.

The results from a research project on snow map-ping in Greenland based on NOAA-AVHRR data is presented. Based on data from two major drain-

age basins, methods for mapping both snow cover and water equivalent is elaborated and validated by use of field observations and hydrological simulation. It is shown that the accuracy in snow cover mapping is greatly increased when a correction for in effects is applied, and that a linear relationship between snow cover and water equivalent can be established. Finally, there is a discussion on the applications of the results in snow hydrology mod-elling, and on the integration of the procedure on a micro-computer based image processing system. (See also W88-08470) (Author's abstract)

MODEL OF THERMAL INERTIA FOR FROST FORECASTING IN AGRICULTURAL AREAS, Valencia Univ. (Spain). Faculty of Physics For primary bibliographic entry see Field 7C. W88-08479

ACTIVE MICROWAVE OBSERVATIONS OF SEA ICE AND ICEBERG, Technical Univ. of Denmark, Lyngby. For primary bibliographic entry see Field 7B. W88-08498

POTENTIAL OF SAR IN A SNOW AND GLA-CIER MONITORING SYSTEM Innsbruck Univ. (Austria). Inst. fuer Meteorologie und Geophysik. ary bibliographic entry see Field 7B. W88-08499

ION-CHROMATOGRAPHIC MENTS OF AMMONIUM, FLUORIDE, ACE-TATE, FORMATE AND METHANESULPHON-ATE IONS AT VERY LOW LEVELS IN ANT-ARCTIC ICE.

Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France). For primary bibliographic entry see Field 5A. W88-08546

PRELIMINARY STUDY ON THE WATER TEMPERATURE AND FREEZING OF LAKE SUWA IN JAPAN AND SHALLOW LAKES IN EASTERN CHINA,

Rissho Univ., Tokyo (Japan). Dept. of Geography. T. Arai, and P. Pu. Japanese Journal of Limnology RIZAA, Vol. 48, No. 3, p 225-230, July 1987. 4 fig, 1 tab, 12 ref.

Descriptors: *Lake ice, *Water temperature, *Freezing, *Ice formation, *Lakes, *Suwa Lake, Japan, China, Shallow water, Epilimnion, Air tem-

Based on the assumption that the extent of winter Based on the assumption that the extent of winter ice in lakes in Japan and central-eastern China may be correlated, the water temperature and condition of freezing were examined in both regions over recent decades (1965-1987) on a monthly basis. Equilibrium temperatures and estimated epilimnion temperatures were used for the prediction of the annual variation of lake temperatures and explanaannual variation of lake temperatures and explana-tion of the formation of ice cover. Lake Suwa freezes almost every year due to its high altitude, whereas the possibility of lake freezing in central-eastern China varies meridionally. January air tem-perature at Nanjing fluctuates in parallel with the temperature at Suwa and appears to be correlated temperature at Suwa, and appears to be correlated with the extent of ice cover in Lake Suwa. (Author's abstract)

EXTENT OF SNOWPACK INFLUENCE ON WATER CHEMISTRY IN A NORTH CASCADES LAKE,

Western Washington Univ., Bellingham. Inst. for Watershed Studies. For primary bibliographic entry see Field 2H.

W88-08665

2D. Evaporation and Transpiration

DESIGN AND EVALUATION OF REGIONAL WEATHER MONITORING NETWORKS. Colorado State Univ., Fort Collins. Dept. of Agri-cultural and Chemical Engineering. For primary bibliographic entry see Field 7A. W88-08058

DOES EVAPORATION OVER THE ARABIAN SEA PLAY A CRUCIAL ROLE IN MOISTURE TRANSPORT ACROSS THE WEST COAST OF INDIA DURING AN ACTIVE MONSOON

National Inst. of Oceanography, Panaji (India). For primary bibliographic entry see Field 2B. W88-08116

GLOBAL ENERGY AND MOISTURE BUDG-ETS FROM RAWINSONDE DATA. Princeton Univ., NJ. Geophysical Fluid Dynamics

For primary bibliographic entry see Field 2B. W88-08118

IMPROVING PRECIPITATION FORECASTS FROM THE METEOROLOGICAL OFFICE FINE-MESH MODEL BY USING A MODIFIED EVAPORATION SCHEME.

Meteorological Office, Bracknell (England). For primary bibliographic entry see Field 2B. W88-08119

WATER RELATIONS AND MORPHOLOGI-CAL DEVELOPMENT OF BARE-ROOT JACK PINE AND WHITE SPRUCE SEEDLINGS: SEEDLING ESTABLISHMENT ON A BOREAL CUT-OVER SITE,

Toronto Univ. (Ontario). Faculty of Forestry. S. C. Grossnickle, and T. J. Blake.
Forest Ecology and Management, Vol. 18, Np 299-318, May, 1987. 9 fig, 47 ref. ent, Vol. 18, No. 4,

Descriptors: *Soil-water-plant relations, *Plant morphology, *Pine trees, *Spruce trees, *Seedlings, *Roots, Morphology, Trees, Growth, Water potentials, Plant water potential, Plant tissues, Vascular tissues, Stomata, Leaves, Humidity.

Bare-root jack pine (Pinus banksiana) and white spruce (Picea glauca) seedlings were planted on a boreal cut-over site and subsequent growth and social cut-over site and susception growth and seedling water relation patterns were monitored over the first growing season. Jack pine seedlings had greater new root development and a lower new shoot/new root ratio, while white spruce seedlings had greater new shoot development. Sea-sonal water relation patterns showed white spruce sonal water relation patterns showed white spruce seedlings to have a greater decrease in xylem presence potential per unit increase in transpirational flux density. These results suggest that the greater resistance to water flow through the soil-plantatmosphere continuum in white spruce seedlings compared to jack pine seedlings may be due to the relative lack of new root development in white spruce. Stomatal response showed that as absolute humidity deficit between the needles and air (AHD) increased, needle conductance (gwv) decreased in both species, but at low AHD levels white spruce had gwv approximately 35% higher than jack pine. White spruce seedlings showed osmotic adjustment over the growing season, while jack pine did not. The implications of morphological development on water relation patterns are discussed with reference to successful reforestation. (Doria-PTT) tion. (Doria-PTT) W88-08203

MODEL OF THERMAL INERTIA FOR FROST FORECASTING IN AGRICULTURAL AREAS, Valencia Univ. (Spain). Faculty of Physics. nary bibliographic entry see Field 7C.

2E. Streamflow and Runoff

OCCURRENCE AND DISTRIBUTION OF SHORTNOSE STURGEON, ACIPENSER BRE-VIROSTRUM, IN THE UPPER TIDAL DELA-Southeastern Louisiana Univ., Hammond. Dept. of

Biological Sciences.
For primary bibliographic entry see Field 5C.
W88-08019

COMPONENTS OF THE SURFACE RADI-ATION BALANCE OF SUBARCTIC WETLAND TERRAIN UNITS DURING THE SNOW-FREE SEASON, McMaster Univ., Hamilton (Ontario). Dept. of Ge-

ography.
P. Laffeur, W. R. Rouse, and S. G. Hardill.
Arctic and Alpine Research ATLPAV, Vol. 19,
No. 1, p 53-63, February 1987. 5 fig, 5 tab, 15 ref.

Descriptors: *Subarctic zone, *Wetlands, *Coastal marshes, *Radiation balance, *Albedo, *Heat balance, Solar radiation, Temperature, Vegetation, Forests, Wind, Seasonal variation, James Bay, Canada, Physical properties.

The magnitude and behavior of net radiation, albedo, and surface radiative temperatures for three coastal wetland sites on southern James Bay were monitored during the snow-free season. The three terrains were a relatively dry coastal backstore, an inner marsh, and an alder-willow forest. Surface wetness was found to be the most important factor prior to vegetation growth. During this period the drier site had an albedo of 0.18, while albedo for the wet marsh and the forest averaged 0.11. Albedos at the wetter sites increased rapidly albedo for the wet marsh and the forest averaged 0.11. Albedos at the wetter sites increased rapidly after the initiation of vegetation growth and during the period of grand growth. The increase in albedo is shown to be linearly related to changes in leaf area. After the vegetation cover was fully estab-lished, albedos at all sites were similar. Net radi-ation in the wetland was primarily determined by albedo and incoming solar radiation. Site to site differences were small in all periods. Although mean daily radiative temperatures were similar at mean daily radiative temperatures were similar at all sites before growth, the backshore had a larger daily temperature range than the wetter sites. Ra-diative temperatures at the forest site averaged 2-3 C less than at the other sites after leafing had occurred. Wind direction had a significant influence on the radiative temperature regime at all sites. Radiative temperatures during onshore winds were substantially smaller than for offshore winds. The implications of this to the surface heat balance are discussed. (Author's abstract) W88-08023

SEDIMENT AND WATER YIELDS FROM MANAGED FORESTS ON FLAT COASTAL PLAIN SITES, Arkansas Univ. at Monticello. Dept. of Forest

Resources. For primary bibliographic entry see Field 2J. W88-08043

EFFECTS OF PRECIPITATION AND LAND USE ON STORM RUNOFF, Geological Survey, Lansing, MI. Water Resources

Div.
R. G. Brown.
Water Resources Bulletin WARBAQ, Vol. 24, No.
2, p 421-426, April 1988. 2 fig, 3 tab, 18 ref.

Descriptors: *Precipitation, *Land use, *Urban hydrology, *Rainfall, *Storm runoff, *Surface runoff, Watersheds, Wetlands, Pollution load, Water quality, Storms, Erosion, Runoff, Minnesota, Urban watersheds, Lakes, Suspended solids, Phosphorus, Nilseson.

Storm-runoff quantity and quality were studied in three watersheds located near St. Paul in Ramsey County, Minnesota, from April 15 through September 15 of 1984, 1985, and 1986 to qualitatively determine the effects of precipitation and selected land uses on storm runoff. In respect to precipitation effects, differences in storm-runoff quantity

Streamflow and Runoff-Group 2E

between years in an urban watershed that lacks between years in an urban watershed that lacks wetlands appear to be related to the average storm size (amount of precipitation) during the study period of each year. In contrast, the differences in storm-runoff quantity from watersheds that contain wetlands appear to be related to total precipitation during study period of each year. In respect to land use, the differences in storm-runoff quantity appear to be related to the amounts of impervious and wetland area. The watershed that contains the and wetland area. The watershed that contains the largest amount of impervious area and smallest amount of wetland area has the largest amount of storm runoff. Differences in storm-runoff quality storm runoit. Differences in storm-runoit quality appear to be related to the amounts of wetland and lake area. The watershed that contains the largest amounts of wetland and lake area has the smallest storm-runoiff loading of suspended solids, phosphorus, and nitrogen. The wetland and lake areas likely retain the loading and, subsequently, lower the amount of storm-runoiff loading exported from watershed (Author's electrical). watershed. (Author's abstract) a watershed W88-08050

FRACTALS AND THE RIVER-LENGTH CATCHMENT-AREA RATIO,

Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.

A. T. Hjelmfelt. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 455-459, April 1988. 4 fig, 3 tab, 6 ref.

Descriptors: *Fractals, *Stream length, *Catch-ment areas, Mapping, Limnology, Hydrology, Model studies, Mathematical studies, Missouri,

The fractal nature of stream-length and catchmentarea measurement is investigated using eight rivers in Missouri. The fractal dimension for the length measurement was found to average 1.158 and for area to average 1.0105. These values are close to those hypothesized previously. The fractal nature of lengths measured from maps probably influences other catchment characteristics. (Author's abstract) stract) W88-08053

DISTRIBUTION OF EPHEMERELLA IGNITA (EPHEMEROPTERA) IN STREAMS: ROLE OF PH AND FOOD RESOURCES, Freshwater Biological Association, Ambleside

For primary bibliographic entry see Field 2H. W88-08078

ALKALINITY AND PH OF TARNS AND STREAMS IN THE ENGLISH LAKE DISTRICT (CUMBRIA).

Freshwater Biological Association, Windermere (England). For primary bibliographic entry see Field 2H. W88-08080

COLONIZATION AND ECOLOGICAL DEVEL-OPMENT OF NEW STREAMS IN GLACIER BAY NATIONAL PARK, ALASKA,

Chelsea Coll., London (England). Dept. of Biolog-For primary bibliographic entry see Field 2H. W88-08095

ROLE OF DRIFT AND EFFECT OF SEASON ON MACOINVERTEBRATE COLONIZA-TION OF IMPLANTED SUBSTRATA IN A TROPICAL AUSTRALIAN STREAM, James Cook Univ. of North Queensland, Towns-

ville (Australia). Dept. of Zoology. For primary bibliographic entry see Field 2H. W88-08098

TEMPERATURE-INDUCED CHANGES IN THE LIFE CYCLE OF LEUCTRA NIGRA (PLE-COPTERA: LEUCTRIDAE) FROM A LAKE DISTRICT STREAM, Freshwater Biological Association, Ambleside

Group 2E-Streamflow and Runoff

For primary bibliographic entry see Field 2H. W88-08102

MICROBIAL ACTIVITY ASSOCIATED WITH SESTON IN HEADWATER STREAMS: EF-FECTS OF NITROGEN, PHOSPHORUS AND

TEMPERATURE,
Virginia Polytechnic Inst. and State Univ., Blacks-burg, Dept. of Biology.
For primary bibliographic entry see Field 2H.
W88-08104

LATE HOLOCENE FLOODING IN THE ECUA-

DORIAN RAIN FOREST, Ohio State Univ., Columbus. Dept. of Zoology. I. Frost, and M. C. Miller. Freshwater Biology FWBLAB, Vol. 18, No. 3, p 443-453, December 1987. 5 fig, 2 tab, 34 ref. NSF

Descriptors: *Floods, *Amazon River Basin, *Historic floods, *Regional floods, *Lake sediments, *Paleohydrology, Ecuador, Rain forests, Flooding, Sediments, Stratigraphy, Lakes, Floods, Amazon River, Radioactive dating, Species diversity.

The stratigraphy, radiocarbon chronology, sedimentary pigment, and cation records of sediment cores from four lakes in the Ecuadorian rain forest show that regional flooding occurred from about 1300 to 800 BP. Each core contains a stratum of allow in the regional notating occurred into about a 1300 to 800 BP. Each core contains a stratum of alluvial clay, silt and sand overlain by lacustrine deposits of peat, gyttja or clayey gyttja. Radiocarbon dates show that the onset and termination of the alluvial event was synchronous across the sites. Short-term, possibly regional, flooding occurred at each of the sites at least once since the major flood. A core from Anangueocha, a black-water lake, records the geochemical signature of white-water incursion during this flooding interval. Sedimentarry pigments show that aquatic production at Anangueocha was low during the lotic interval but rose sharply and remained high within the modern lake period. The Amazon's dynamic river system may have been an important force in promoting and maintaining high floral and faunal diversity. (Author's abstract) W88-08107

SPATIAL DISTRIBUTION OF TRICHOPTERA LARVAE IN THE SEDIMENTS OF AN AUSTRIAN MOUNTAIN BROOK, Vienna Univ. (Austria). Zoologisches Inst. For primary bibliographic entry see Field 2H. W88-08109

EVIDENCE FOR THE USE OF NON-DETRI-TAL DISSOLVED ORGANIC MATTER BY MI-CROHETEROTROPHS ON PLANT DETRITUS IN A WOODLAND STREAM,

Georgia Univ., Athens. Inst. of Ecology. For primary bibliographic entry see Field 2H. W88-08110

ALTERATIONS IN PERIPHYTON CHARAC-TERISTICS DUE TO GRAZING IN A CASCADE

Washington Univ., Seattle. Dept. of Environmen-tal Engineering and Science. For primary bibliographic entry see Field 2H. W88-08111

MACRO-FLORAL ASSEMBLAGES IN UPLAND WELSH STREAMS IN RELATION TO ACIDITY, AND THEIR IMPORTANCE TO

INVERTEBRATES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 2H.
W88-08113

HYDRAULIC AND SOIL MECHANICAL AS-PECTS OF RILL GENERATION ON AGRICUL-

TURAL SOILS, Katholieke Univ. Leuven (Belgium). Lab. voor Experimentele Geomorfologie.

For primary bibliographic entry see Field 2J. W88-08135

TOTAL BACTERIAL CELL COUNTS AND ESTERASE-ACTIVITY IN A SMALL UNPOLLUTED STREAM DURING THE MAIN VEGETA-TIVE PERIOD,

Gesamthochschule Essen (Germany, F.R.). Fach-bereich 9 - Geologie. For primary bibliographic entry see Field 5B. W88-08163

NOTE ON THE REPRESENTATION OF NON-LINEARITY IN RUNOFF PROCESS BY THE GENERAL HYDROLOGIC SYSTEM MODEL, Centre for Water Resources, Madras (India). For primary bibliographic entry see Field 2A. W88-08182

DIFFUSION (DHM), HYDRODYNAMIC MODEL

Williamson and Schmid, Irvine, CA. For primary bibliographic entry see Field 2A. W88-08184

DEFORESTATION AND FLOODS, For primary bibliographic entry see Field 4C. W88-08217

COMBINED MEASUREMENTS OF SUBGLA-CIAL WATER PRESSURE AND SURFACE VE-LOCITY OF FINDELENGLETSCHER, SWIT-ZERLAND: CONCLUSIONS ABOUT DRAIN-AGE SYSTEM AND SLIDING MECHANISM, Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalf tuer Wasserbau, Hydrologie und Glaziologie. For primary bibliographic entry see Field 2C. W88-08235

DISCHARGES OF TURBID WATER DURING MINI-SURGES OF VARIEGATED GLACIER,

ALASKA, U.S.A., Washington Univ., Seattle. Geophysics Program. For primary bibliographic entry see Field 2F. W88-0823

EFFECTS OF IRRADIANCE ON THE COMMUNITY STRUCTURE AND BIOMASS OF ALGAL ASSEMBLAGES IN LABORATORY STREAMS, Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology. For primary bibliographic entry see Field 2H. W88-08260

HYDROLOGICAL ANALYSIS OF BASIN BE-HAVIOR FROM SOIL MOISTURE DATA,

Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society. For primary bibliographic entry see Field 2G. W88-08291

SNOWMELT RUNOFF IN SUBURBAN ENVI-RONMENTS, Trent Univ., Peterborough (Ontario). Dept. of Ge-

ography.
For primary bibliographic entry see Field 4C. W88-08292

COMPARATIVE ANALYSIS OF SOME EXPLICIT-IMPLICIT STREAMFLOW MODELS, Port Harcourt Univ. (Nigeria). Dept. of Civil En-

I. L. Nwaogazie. Advances in Water Resources AWREDI, Vol. 10, No. 2, p 69-77, June 1987. 8 fig, 2 tab, 18 ref,

Descriptors: *Model studies, *Streamflow, *Mathematical models, Galerkin finite element method, Newton-Raphson iterative method, Hydrographs, Comparison studies, Computers.

The numerical performance and cost analysis for four streamflow models are presented. These models are constructed from the well-known equations of Saint Venant. The Galerkin finite element models are constructed from the well-known equations of Saint Venant. The Galerkin finite element method and the Newton-Raphson iterative method were utilized for the solution of depth and velocity of flow. Because of the large computer storage associated with complete solutions of Saint Venant equations, particularly for floods of long durations, the approximate models (kinematic- and diffusion-waves) were introduced to investigate the savings which could be made by using each of these models. Model predictions were contrasted with previously found solutions of a flood-wave in an idealized geometry. The effects of a large time step and the time-weighting factor for implicit models on cost and the numerical distortion of the hydrographs were examined. Results indicate that the computer cost is a direct function of the level of model approximation. For field application of the implicit models, regression equations relating: (1) Manning's roughness coefficient and discharge; (2) area and depth of flow, and (3) top-width and depth of flow were utilized. Relative to idealized channel the degree of nonlinearity for the natural channel not only affected model performance but increased the amount of computations and thus the cost. Convergence and unconditional stability were observed for implicit models for the time-weighting factor in the range of 0.55 and 1.00. For the explicit model, instability restricted the choice of time step. (Author's abstract) of time step. (Author's abstract) W88-08342

USE OF RORB AND SWMM MODELS TO AN URBAN CATCHMENT IN SINGAPORE, National Univ. of Singapore. Dept. of Civil Engi-

neering. For primary bibliographic entry see Field 4A. W88-08343

STATISTICAL INTERCOMPARISON OF EVI ESTIMATORS BY MONTE CARLO SIMULA-

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.

K. Arora, and V. P. Singh.

Advances in Water Resources AWREDI, Vol. 10, No. 2, p 87-107, June 1987. 2 fig, 9 tab, 13 ref.

Descriptors: *Flood frequency, *Frequency analysis, *Statistical analysis, *Monte Carlo method, *Estimating equations, Model studies, Comparison studies.

The objective of flood frequency analysis is to estimate the magnitude of extreme flow events corresponding to a specified recurrence interval or exceedance probability. Many probabilistic models have been employed for at site flood analysis. At the same time, several estimators have been proposed for each model. An assessment was made of the behavior of several estimators available for the the behavior of several estimators available for the Gumbel's extreme value type 1 (EV1) distributions. EV1 distribution parameters and quantiles were estimated by methods of moments, maximum likelihood estimation, probability weighted moments, entropy, mixed moments, least squares and incomplete means for Monte Carlo samples generated from two sampling cases: a purely random process and a serially correlated process. The performance of these estimators was statistically intercompared. Additionally, a bias correction was formance of these estimators was statistically inter-compared. Additionally, a bias correction was made to the method of moments-quantile estima-tion. The corrected estimator provided nearly un-biased quantile estimates even for small samples and high nonexceedance probabilities. (Author's abstrace) abstract) W88-08344

ANALYSIS OF OBJECTIVE FUNCTIONS USED IN URBAN RUNOFF MODELS,

Purdue Univ., Lafayette, IN. School of Civil Engi-

For primary bibliographic entry see Field 4C.

COMPARISON OF THREE METHODS FOR REGIONAL FLOOD FREQUENCY ANALYSIS IN SAUDI ARABIA, King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering. M Noub.

Advances in Water Resources AWREDI, Vol. 10, No. 4, p 212-219, December 1987. 2 fig, 6 tab, 18

Descriptors: *Runoff, *Flood data, *Flood frequency, *Frequency analysis, Flood basins, Catchment areas, Rainfall, Flood peak, Runoff volume, Saudi Arabia, Comparison studies.

Saudi Arabia, Comparison studies.

This study compared the relative accuracy of three methodologies of regional flood frequency analysis in areas of limited flood records. Thirty-two drainage basins of different characteristics, located mainly in southwest Saudi Arabia, were selected. In the first methodology, region curves were developed and used together with the mean annual flood, estimated from the characteristics of drainage basin, to estimate flood flows at a location in the basin. The second methodology was to fit probability distribution functions to annual maximum rainfall intensity in a drainage basin. The best fitted probability function was used together with common flood peak flow models to estimate the annual maximum flood flows in the basin. In the third methodology, duration reduction curves were developed and used together with the average flood flow in a basin to estimate the peak flood flows in the basin. The results from each method were compared to the flood records of the selected stations using three statistical measures of goodness-of-fit. The first methodology was found best in a case of having short length of record at a drainage basin. The second methodology produced satisfactory results. It is recommended in areas where data are not sufficient and/or reliable to utilize the first methodology. (Author's abstract) W88-08355

ESTIMATING 100-YEAR FLOOD CONFIDENCE INTERVALS, California Univ., Irvine. Ept. of Mathematics. R. J. Whitley, and T. V. Hromadka. Advances in Water Resources AWREDI, Vol. 10, No. 4, p 225-227, December 1987. 4 tab, 20 ref.

Descriptors: *Flood data, *Frequency analysis, *Flood recurrence interval, *Streamflow, *Runoff, *Flood frequency, *Design floods, Simulation analysis, Estimating.

The estimation of the 100-year flood, or more generally, the T-year flood, is a basic problem in hydrology. An important source of uncertainty in this estimate is that caused by the uncertaint estimation of parameters of the flood distribution. This importainty can have a significant effect on the tion of parameters of the flood distribution. This uncertainty can have a significant effect on the flood design value, and its quantification is an important aspect of evaluating the risk involved in a chosen level of flood protection. In this paper, simulation is used to determine confidence intervals for the flood design value. The simulation allows verification of Stedinger's formula not only as it applies to confidence intervals, but also verifies the formula as an approximation to percentiles as well. (Author's abstract)

W88-08357

RIVER FLOW FORECASTING FOR MULTI-PLE TIME PERIODS, Manitoba Univ., Winnipeg. Dept. of Civil Engi-

Canadian Journal of Civil Engineering CJCEB8, Vol. 15, No. 1, p 58-65, 1988. 3 fig, 6 tab, 7 ref.

Descriptors: *Steamflow forecasting, *River flow, *River forecasting, Precipitation, Snowmelt, Temperature, Algorithms.

The performance of a river flow forecasting model employing a Kalman filtering algorithm was evaluated for increasing forecast lead times. The expected decrease in forecast accuracy was quantified and a decrease in forecast precision was noted for increased lead times. The merits of external estimates of the contract of the contract

mates of meteorological inputs to the model were evaluated through an examination of different fore-casting options. It was revealed that even noisy estimates of meteorological events improved the flow forecasts. (Author's abstract) W88-08361

TOXICITY AND CHEMICAL COMPOSITION OF URBAN STORMWATER RUNOFF, British Columbia Univ., Vancouver. Westwater Research Centre. For primary bibliographic entry see Field 5C. W88-08364

THREE INSTRUMENTS USED IN RAINFALL-RUNOFF SIMULATION EXPERIMENTS, Academia Sinica, Beijing (China). Inst. of Geogra-

For primary bibliographic entry see Field 7B. W88-08368

CHLORIDE IN PRECIPITATION AND STREAMWATER FOR THE UPLAND CATCH-MENT OF RIVER SEVERN, MID-WALES: SOME CONSEQUENCES FOR HYDROCHE-MICAL MODELS, Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 2K. W88-08369

MODEL OF RIVER FLOW FORECASTING FOR A SMALL FORESTED MOUNTAIN CATCHMENT,

Kyoto Univ. (Japan). Dept. of Forestry. For primary bibliographic entry see Field 2A. W88-08370

SPATIO-TEMPORAL DYNAMICS OF MA-CROINVERTEBRATE MOVEMENTS IN A LARGE RIVER OFFINIOUS SPATIO-TEM-PORELLE DES DEPLACEMENTS DE MA-CROINVERTEBRES DANS UNE GRANDE RI-

VIEWEJ, Lyon-I Univ., Villeurbanne (France). Lab. d'Eco-logie des Eaux Douces. For primary bibliographic entry see Field 2H. W88-0838.

FLOODS ON EAST FORK MULBERRY CREEK AND PRICE BRANCH IN THE VICINITY OF LYNCHBURG, TENNESSEE. Tennessee Valley Authority, Knoxville. Office of

Natural Resources and Economic Developn For primary bibliographic entry see Field 4A. W88-08393

EASTERN SUBBASIN LOW PLOW MANAGE-MENT FRAMEWORK PLAN, Susquehanna River Basin Commission, Harrisburg,

For primary bibliographic entry see Field 4A. W88-08395

PACIFIC NORTHWEST RIVERS STUDY: AS-SESSMENT GUIDELINES, MONTANA, Montana Dept. of Fish, Wildlife and Parks,

Available from the National Technical Information Service, Springfield, VA 22161, as DE87-011160. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/BP-756, December 1986. 123 p, 1 fig, 4 tab, 53 ref, 4 append.

Descriptors: *Rivers, *Water resources development, *Montana, *Standards, Environmental policy, Environmental impact statement.

The Rivers Study was designed to produce a consistent and verifiable river resource data base. While this information may prove useful for a variety of applications, the specific purpose of the project was to identify resource considerations which might affect hydropower development. The goal of the project was to evaluate and document

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the significance of individual river segments and aystems for a variety of natural resource values. Comparative assessment was a major feature of asystems for a variety of natural resource values. Comparative assessment was a major feature of this process. Field survey was kept to a minimum. The study relied on currently available information and evaluation by recognized resource experts. The following is a stepwise description of the assessment process: (1) Identification of River Resource Categories; (2) Inventory of Information and Identification of Experts; (3) Criteria and Standards Development; (4) Individual Resource Category Evaluation; (5) Display and Review of Resource Category Finding; (6) Information Synthesis; and (7) Presentation and Documentation. In order to standardize the assessment process and the resulting products, a number of regionwide production guidelines were established. This document presents the process that participants followed to complete the Pacific Northwest Rivers Study. It identifies assessment guidelines for each Study. It identifies assessment guidelines for each river resource category and provides reporting formats for data collection and presentation. (Lantz-PTT) W88-08409

FISH SPECIES ASSEMBLAGES IN SOUTH-WESTERN WISCONSIN STREAMS WITH IM-PLICATIONS FOR SMALLMOUTH BASS MANAGEMENT, Wisconsin Dept. of Natural Resources, Madison. For primary bibliographic entry see Field 2H. W88-08425

OLD RIVER OVERBANK STRUCTURE, LOUISIANA: HYDRAULIC MODEL INVESTIGA-

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8B. W88-08514

FAULT-TOLERANT DESIGN FOR DATA ACQUISITION AND FLOOD FORECAST SYS-

Sierra-Misco, Inc., Sacramento, CA. For primary bibliographic entry see Field 4A. W88-08548

GLOBAL TRENDS IN THE NATURE OF OR-GANIC MATTER IN RIVER SUSPENSIONS, Hamburg Univ. (Germany, F.R.). Geologisch-Pa-laeontologisches Inst. und Museum.

Nature NATUAS, Vol. 332, No.6163, p 436-438, March 1988. 2 fig, 1 tab, 28 ref.

Descriptors: *Rivers, *Organic matter, *Organic carbon, *Marine sediments, *Sediment transport, *Sedimentation, Sediments, Chemical analysis, Nitrogen, Estuario

Riverine organic matter consists of a labile (metabolizable) and a residual (non-metabolizable) fraction. The labile fraction can be oxidized or 'lost' within the rivers, their estuaries, and in the marine environment. Previous estimates of the river fluxes of organic carbon have not considered such potential losses, being based on measurements of the bulk carbon and nitrogen contents. Detailed chembulk carbon and nitrogen contents. Detailed chemical analyses of organic matter associated with suspended from several major world rivers are reported that have allowed differentiation into labile and refractory fractions. Globally, 35% (81 times 10 to the 12th power g per Cyr) of it belongs to the labile fraction and may become oxidized in estuaries and in the marine environment. The rest estuaries and in the marine environment. The rest (150 times 10 to the 12 power g per Cyr) appears to be highly degraded, with the bulk entering present-day subtropical sea areas. This degraded fraction could represent a significant source of organic carbon accumulating in marine sediments. (Author's abstract) W88-08559

SUBSTANCES IN RIVERS AND

STREAMS, Nature Conservancy Council, Peterborough (Eng-

Group 2E-Streamflow and Runoff

For primary bibliographic entry see Field 5C. W88-08562

LAGRANGIAN TRANSPORT MODELING WITH QUAL II KINETICS, Geological Survey, Tampa, FL. For primary bibliographic entry see Field 5B. W88-08575

BIOLOGICAL SURVEILLANCE OF WATER QUALITY: 3, THE INFLUENCE OF ORGANIC ENRICHMENT ON THE MACROINVERTE-BRATE FAUNA OF SMALL CHALK STREAMS, Freshwater Biological Association, Wareham (England). River Lab. For primary bibliographic entry see Field 5A. W88-08595

QUANTITATIVE RESPONSES OF CHIRONO-MID COMMUNITIES TO TWO WATER VE-LOCITY REGIMES DURING A SPRING BLOOM OF EPILITHIC ALGAE, Freshwater Biological Association, Wareham (England). River Lab. For primary bibliographic entry see Field 2H. W88-08596

TEMPORAL AND SPATIAL PATTERNS OF NITRATE LOSSES FROM AN AGRICULTUR-AL CATCHMENT, Oxford Univ. (England). Geography School. For primary bibliographic entry see Field 5B. W88-0860.

NITROGEN INPUTS AND OUTPUTS IN A SMALL AGRICULTURAL CATCHMENT IN THE EASTERN PART OF THE UNITED KING-DOM, Institute of Hydrology, Wallingford (England). For primary bibliographic entry see Field 5B.

DYNAMICS OF A TROPICAL FLOODPLAIN ENVIRONMENT WITH REFERENCE TO FOREST ECOLOGY, Bristol Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 2A. W85-03603.

IMPACT OF HYDROELECTRIC DEVELOP-MENT ON THE AMAZONIAN ENVIRON-MENT: WITH PARTICULAR REFERENCE TO THE TUCURUI PROJECT, University Coll. of Swansea (Wales). Centre for Development Studies. For primary bibliographic entry see Field 6G. W88-08604

RADIONUCLIDE LEVELS IN RIVER SEDI-MENT NEAR TO A TREATED EFFLUENT OUTFALL, Ministry of Defence, Aldermaston (England). Atomic Weapons Research Establishment. For primary bibliographic entry see Field 5B. W88-08610

RODERO CREEK: RISING WATER ON THE HIGH DESERT, Nevada Univ., Reno. Dept. of Range, Wildlife and For primary bibliographic entry see Field 2H. W88-08621

MIXING OF RIVER WATER IN RIVER YODO,

Osaka City Univ. (Japan). Faculty of Engineering M. Ioi, H. Kushibe, T. Kitada, W. Tatebe, and R.

Japanese Journal of Limnology RIZAA, Vol. 48, No. 1, p 19-24, January 1987. 6 fig, 3 tab, 3 ref.

Descriptors: *Mixing, *River flow, *Yodo River, *Dissolved solids, Flow pattern, Tributaries, Am-

monium, Phosphates, Sodium, Potassium, Silica, Load distribution, Tracers, Correlation coefficient.

Using dissolved conservative constituents in river waters, the mixing of flowing waters was studied between 13 km downstream and the junction where the River Kizu from the left side, the River Uji from the middle, and the River Katsura from the right side, converge to form the River Yodo. The concentrations of ammonium, phosphate sodium and potassium in river waters on the right side of the River Yodo were always higher than those found on the left side to about 13 km downstream. The amounts of silica, sodium and potassium calculated from their concentrations and flow volume in the River Yodo were in good agreement with the sum of their amounts from the three tributaries. Using each flow volume estimated from the concentrations of silica and sodium (or potassimum) in tributaries, the contribution ratio of ammo-Using dissolved conservative constituents in river the concentrations of sinca and sodium (or potassi-um) in tributaries, the contribution ratio of ammo-nium and phosphate loading to the River Yodo was calculated and found to be in good agreement with the measured loadings. The results suggest that the removal of ammonium and phosphate during flow downstream might not occur, and that silica can be used as a conservative tracer of the mixing of flowing water as well as sodium and potassium. (Author's abstract) W88-08630

CHARACTERISTICS OF GENERIC COMPOSI-TION OF AEROBIC HETEROTROPHIC BAC-TERIA IN PERIPHYTON AT AN OLIGOTRO-PHIC REGION IN THE TAMAGAWA RIVER, Tokyo Univ. of Agriculture and Technology (Japan). Lab. of Biology. For primary bibliographic entry see Field 2H. W88-08633

WATER QUALITY FORMATION OF INLAND WATER IN THE DRAINAGE BASIN OF LAKE CHUZENJI, NIKKO, (IN JAPANESE), Tochigi Prefectural Research Inst. for Environmental Pollution, Utsunomiya (Japan). For primary bibliographic entry see Field 2H. W88-08652

HYDROLOGIC CONTROL OF ALUMINUM CHEMISTRY IN AN ACIDIC HEADWATER STREAM,
Maine Univ. at Orono. Dept. of Plant and Soil

For primary bibliographic entry see Field 5B. W88-08659

SOIL LIMING AS A MEASURE TO MITIGATE ACID RUNOFF, Lund Inst. of Tech. (Sweden). Dept. of Chemical Engineering. For primary bibliographic entry see Field 5G. W88-08663

STABLE WIDTH AND DEPTH OF STRAIGHT GRAVEL RIVERS WITH HETEROGENEOUS BED MATERIALS,

Saitama Univ., Urawa (Japan). Dept. of Founda-

Saitama Univ., Urawa (Japan). Dept. of Founda-tion Engineering. S. Ikeda, G. Parker, and Y. Kimura. Water Resources Research WRERAO, Vol. 24, No. 5, p 713-722, May 1988. 11 fig, 2 tab, 24 ref. Ministry of Education of Japan grant-in-aid for Scientific Research No. 59020003.

Descriptors: *Bed load, *Alluvial channels, *Chan-Descriptors: 'Bea toad, "Alluvial channels, "Chan-nel morphology, "Mathematical models, "Hydro-logic models, "Stable channels, "Gravel rivers, Stability analysis, Water depth, Channel flow, Rivers, Heterogeneity, River beds, Turbulent flow, Slopes, Flow discharge, Model testing, Streambeds, Sediment transport.

A mathematical model for defining a stable width and depth of straight gravel rivers revealed that the major agency for maintaining a stable channel is lateral diffusion of the longitudinal fluid momentum due to turbulence. The primary quantities which determine the stable channel geometry are flow discharge, longitudinal free surface slope, the

median size of bed material, and gradation of the bed material. Increasing gradation increases the depth and decrease the width. Introduction of one loose and one rigid bank in laboratory experiments provided good examples to test the model, in which four kinds of sand were used to test the gradation effect. These laboratory data support the mathematical model. The theory also performed well when it was applied to natural gravel rivers and canals excavated in coarse bed materials. The bed load transport rate calculated from the predicted bed shear stress is also generally supported by the laboratory results. (Author's abstract) W88-08664

DIFFUSION WAVE MODEL FOR OVERLAND FLOW: I. SOLUTION FOR STEEP SLOPES, California Univ., Davis. Dept. of Civil Engineer-

ing.
R. S. Govindaraju, S. E. Jones, and M. L. Kavvas.
Water Resources Research WRERAO, Vol. 24,
No. 5, p 734-744, May 1988. 4 fig, 1 tab, 13 ref.
NSF grant CEE-8411896 and USDI grant G-90803 (A-098-KY).

Descriptors: *Rainfall-runoff relationships, *Kinematic wave theory, *Diffusivity, *Mathematical models, *Overland flow, *Diffusion wave model, Slopes, Hydrographs, Watersheds, Mathematical analysis, Streams, Runoff, Approximation method.

analysis, Streams, Runoff, Approximation method. A new solution technique for analyzing the overland flows on lands adjacent to stream networks is presented. Some of the practical short-comings of the state-of-the-art kinematic wave model are discussed. As boundary conditions for steep slopes, homogeneous end conditions of zero depth at the upstream and zero-depth gradient at the downstream were found to represent the physical saturation adequately. A weighted residual method was used to develop an approximate solution to the problem. The trial functions were taken to be the spatial eigenfunctions of the corresponding homogeneous problem. It is demonstrated that the results agree well with the full Saint Venant solution and the kinematic wave approximation. It is also shown that the numerical solution to the diffusion wave approximation agrees very well with the weighted residual approximation for only a small number of terms. Both the rising and recession phases of the outflow hydrograph have been considered. The approximation can accommodate time and space variation in rainfall. (See also W88-08668) (Author's abstract)

DIFFUSION WAVE MODEL FOR OVERLAND FLOW: II. STEADY STATE ANALYSIS, California Univ., Davis. Dept. of Civil Engineer-

ing.

R. S. Govindaraju, S. E. Jones, and M. L. Kavvas.
Water Resources Research WRERAO, Vol. 24,
No. 5, p 745-754, May 1988. 5 fig. 5 ref. NSF grant
CEE-8411896 and USDI grant G-908-03 (A-098-

Descriptors: *Diffusivity, *Mathematical models, *Overland flow, *Diffusion wave model, *Steady flow, *Kinematic wave theory, *Rainfall-runoff relationships, *Equilibrium, *Boundary conditions, Fluctuations, Watersheds, Mathematical analysis, Streams, Runoff.

Results on analysis of the steady state phase of the diffusion wave model solution are presented. It is physically obvious that a steady state is reached for constant rainfall, since the depth of overland flow at the outflow section increases until equilibrium is achieved and continuity is satisfied. Numerical and analytical steady state results for flux type boundary conditions are presented as new material. The upstream boundary condition is one of zero inflow. Both the zero-depth gradient and the critical depth downstream boundary conditions were investigated. For steep slope situations, the upstream boundary condition of zero depth adopted in the first paper was found to be justified. A method of finding the complete solution (i.e., including the time-dependent part) by superimposing the steady

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state profile and a transient component is discussed for the zero-depth gradient lower end condition. The steady state results show that the critical depth condition at the downstream boundary is a stringent requirement and therefore is likely to pose problems. This helps in understanding why some of the numerical techniques used by previous researchers failed for certain parameters. (See also W88-08667) (Author's abstract)

TEMPORAL SAMPLING AND DISCHARGE ASYMMETRY IN SALT MARSH CREEKS, Manchester Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 2L.

FOREST HARVEST AND SITE PREPARATION EFFECTS ON STORMFLOW AND PEAKFLOW OF EPHEMERAL STREAMS IN THE OUA-CHITA MOUNTAINS,

oma State Univ., Stillwater. Dept. of Forest-

ry. For primary bibliographic entry see Field 4C. W88-08755

THERMAL REGIME OF THE LOWER AR-DECHE RIVER (LE REGIME THERMIQUE DES EAUX DE L'ARDECHE DANS SON

COURS INFERIEUR), Lyon-1 Univ., Villeurbanne Biologie Animale et Ecologie. S. Doledec. anne (France). Dept. de

Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 1, p 29-41, 1987. 6 fig, 3 tab, 22 ref.

Descriptors: *Temperature effects, *Water temperature, *Rivers, *Ardeche River, Seasonal variation, Air temperature, Geomorphology, Hydrolo-

A study of the thermal regime of the Lower Ardeche River in France was carried out from July 1982 to December 1984 using a chemical method (sucrose inversion) and a continuous temperature recorder. Yearly, monthly and daily temperature fluctuations were analyzed. The main factors that influence thermal variations are air temperature influence thermal variations are air temperature and geomorphology of the canyon. The hydrological regime is responsible for the water temperature fluctuations between years. Despite the low winter temperatures, the Lower Ardeche can be classified among Mediterranean rivers, which typically have a very high maximum temperature in summer. (Author's abstract)

EFFECT OF INTENSIVE FERTILIZATION OF A BANKSIDE MEADOW ON THE ACTIVITY OF PLANKTON BACTERIA IN THE RIVER NIDA (SOUTHERN POLAND), Polish Academy of Sciences, Krakow. Zaklad Bio-

For primary bibliographic entry see Field 5C. W88-08835

EFFECT OF DAM RESERVOIRS ON OLIGO-CHAETE COMMUNITIES IN THE RIVER DUNAJEC (SOUTHERN POLAND), Polish Academy of Sciences, Krakow. Zaklad Bio-For primary bibliographic entry see Field 2H. W88-08837

DIVERSITY AND NUMBERS OF OLIGO-CHAETA AGAINST THE BACKGROUND OF OTHER MACROINVERTEBRATES IN A CON-CRETE BED OF THE RIVER WIDAWKA (CEN-TRAL POLAND), Lodz Univ. (Poland). Inst. of Environmental Biol-

ogy. For primary bibliographic entry see Field 2H. W88-08838

BENTHOS AND DRIFT OF INVERTEBRATES, PARTICULARLY CHIRONOMIDAE, IN A SE-

LECTED CROSS-SECTION PROFILE OF THE RIVER WIDAWKA (CENTRAL POLAND), Lodz Univ. (Poland). Dept. of Ecology and Verte-brate Zoology. For primary bibliographic entry see Field 2H. Wys.nesus.

HYDROBIOLOGICAL STUDY OF THE OSSAU VALLEY (ATLANTIC PYRENEES): I. DISTRIBUTION AND ECOLOGY OF EPHEMEROPTERA (ETUDE HYDROBIOLOGIQUE DE LA VALLEE D'OSSAU (PYRENEES-ATLANTIQUES): I. REPARTITION ET ECOLOGIE DES EPHEMEROPTERES), For primary bibliographic entry see Field 2H. W88-08844

ECOLOGY OF A FREE-FLOWING RIVER IN THE SOUTH OF THE ALPS- THE BUECH (FRANCE): I. LONGITUDINAL EVOLUTION OF PHYSICAL AND CHEMICAL DESCRIP-TORS (ECOLOGIE D'UNE RIVIERE NON AMENAGEE DES ALPES DUE SUD- LE BUECH: (FRANCE) I. EVOLUTION LONGITU-DINALE DES DESCRIPTEURS PHYSIQUES ET CHIMIQUES), Aix-Marseille-1 Univ. (France). Lab. d'Hydrobio-

For primary bibliographic entry see Field 5C. W88-08845

HYDROBIOLOGICAL STUDY OF THE OSSAU VALLEY (ATLANTIC PYRENEES) II: THE EN-VIRONMENT AND THE STRUCTURE OF THE VIRONMENT AND THE STRUCTURE OF THE BENTHIC POPULATION, (ETUDE HYDRO-BIOLOGIQUE DE LA VALLEE D'OSSAU (PYRENEES-ATLANTUES) II: LE MILIEU ET LA STRUCTURE DU PEUPLEMENT BENTHI-

Toulous-3 Univ. (France). Lab. d'Hydrobiologie. For primary bibliographic entry see Field 2H. W88-08846

FACTORS CONTROLLING PRIMARY PRO-DUCTION IN TWO RIVERS RESULTING FROM A REDUCTION IN FLOW, (FACTEURS CONTROLANT LA PRODUCTION PRIMAIRE DANS DEUX RIVIERES SOUMISES A UNE FORTE REDUCTION DE DEBIT),

Quebec Univ., Montreal. Dept. of Biological Sci-For primary bibliographic entry see Field 2H. W88-08872

TYPOLOGY OF OLIGOTROPHIC STREAMS OF THE ARDENNE (BELGIUM) BY MULTI-VARIATE ANALYSIS OF BENTHIC DIATOMS RECORDS (TYPOLOGIE DES RIVIERES OLI-GOTROPHES DU MASSIF ARDENNAIS (BEL-GIQUE) PAR L'ANALYSE MULTIVARIEE DE BET EVES DE DIATOMERS BENTHIJONIES RELEVES DE DIATOMEES BENTHIQUES), Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Botanique. For primary bibliographic entry see Field 2H. W88-08873

EXPERIMENT ON FLUIDIZATION IN UNBOUNDED DOMAINS, Lehigh Univ., Bethlehem, PA. Dept. of Civil En-

gineering. R. N. Weisman, G. P. Lennon, and E. W. Roberts. Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 5, p 502-515, May 1988. 9 fig, 1 tab, 12 ref,

Descriptors: *Model studies, *Flow rates, *Hydraulic engineering, *Hydraulic models, *Fluidization, *Flow, *Fluid flow, Two-dimensional flow rate, One-dimensional flow rate, Hydraulic head.

This experimental study advances the fundamental understanding of two-dimensional fluidization and provides a data base for future numerical modeling. The study was performed in a 365.7 cm by 121.9 cm by 30.4 cm (12 ft by 4 ft by 1 ft) tank filled with sand overlying a small source pipe. The back panel contains 143 pressure taps used to de-

termine the hydraulic head distribution. For the bed depths tested, the lines of constant hydraulic head are horizontal in the fluidized region and curve downward in the unfluidized region. The one-dimensional theoretical superficial velocity needed to initiate fluidization provides a reasonable approximation of the two-dimensional incipient fluidization conditions. The average sand concentration in the fluidized region decreases with increased flow rate. The total leakage occurring across the interface from the fluidized region to the unfluidized region was determined to be less than 5% of the total fluidization flow rate entering the system. (Author's abstract) system. (Author's abstract) W88-08915

IMPROVED FITTING FOR THREE-PARAME-TER MUSKINGUM PROCEDURE, Lancaster Univ. (England). Dept. of Environmen-

Lal Sciences.
T. O'Donnell, C. P. Pearson, and R. A. Woods.
Journal of Hydraulic Engineering JHEND8, Vol.
114, No. 5, p 516-528, May 1988. 5 fig. 7 tab, 4 ref,

Descriptors: *Muskingum procedure, *Flood routing, *Model studies, *Parametric hydrology, *Hydrograph analysis, *New Zealand, Hydraulic engineering, Floods, Matrix-inversion method, Hydraulic models, Parameter estimation, Reach storage coefficient, Weighting factors, Mathematical models, Grey River.

A method that allows better use of available data from a flood event is presented for the three-parameter Muskingum flood-routing procedure. The procedure is based upon the three-parameter Muskinghum model, where the two conventional Muskinghum model, where the two conventional parameters (the reach storage coefficient and the inflow/outflow weighting factor) are augmented by a third parameter to account for lateral inflow in to the reach. Parameter estimation for the three-parameter model is performed objectively by a matrix-inversion method. The flood-routing procedure consists of randomly splitting a group of flood events into two groups so that the three-parameter model can be calibrated on one group and evaluated on the other, and vice versa. This procedure is improved by adjusting the previous parameter estimation scheme so that full advantage is taken of both the time interval at which the data is recorded and the lag time between the upstream and downstream hydrograph peaks. An application of the full, improved procedure is given using flood events from the Grey River on the West Coast of the South Island, New Zealand. (Author's abstract) abstract) W88-08916

OIL SLICK TRANSPORT IN RIVERS.

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5B. W88-08917

SUBCRITICAL FLOW IN RIGID-BED OPEN CHANNEL EXPANSIONS, For primary bibliographic entry see Field 8B. W88-0895

2F. Groundwater

SEEPAGE IN A SATURATED-STRATIFIED AQUIFER WITH RECHARGE, Agricultural Research Service, Riverside, CA. Sa-

linity Lab. S. R. Yates.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 356-363, March-April 1988. 6 fig, 3 tab, 18

Descriptors: *Seepage, *Groundwater movement, *Aquirers, *Soil layers, *Model studies, *Mathematical studies, *Soil water, *Anisotropy, *Groundwater recharge, Hydrology, Recharge

An analytical solution for the flow of water through a large-scale laboratory aquifer consisting

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of three soil layers is presented. It is assumed that each layer is saturated, that the soil is homogeneous but may be anisotropic and that the flow of water in each layer is two-dimensional; that is, the flow at the inflow and outflow boundary is uni-form over the entire aquifer width. The solution form over the entire aquiter width. In a solution includes a flux boundary condition at the surface which allows recharge to, or a loss from, the upper aquifer. The solution is presented in terms of the hydraulic head and the stream function. The features of the solution are illustrated with several examples. (Author's abstract)

W88-47991

EXPERIMENTAL VERIFICATION OF MULTI-COMPONENT GROUND WATER CONTAMI-NATION PREDICTIONS,
Michigan Dept. of Natural Resources, Lansing.
Waste Management Div.
For primary bibliographic entry see Field 5B.
W88-38037

CALIBRATION OF WATER-BALANCE MODEL FOR SMALL WATER-BALANCE MODEL FOR SMALL WATERSHEDS IN EASTERN OREGON, Chequamegon National Forest, Park Falls, WI. For primary bibliographic entry see Field 2A. W38-03042

GOES IR AND DUMMY VARIABLE TECH-NIQUES FOR LOW TEMPERATURE ASSESS-MENT IN FLORIDA, Florida Univ., Gainesville. Remote Sensing Appli-For primary bibliographic entry see Field 7C. W88-08044

GROUNDWATER RECHARGE PLANNING USING RESOLVENT DISCRETE KERNELS. Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering. R. C. Peralta, K. G. Kowalski, and H. J. Morel-

Seytoux.

American Society of Agricultural Engineers

TAAEAJ, Vol. 30, No. 6, p 1694-1699, November-December 1987. 2 fig. 1 tab, 31 ref.

Descriptors: *Resolvent discrete, kernels, *Re-charge basins, *Groundwater recharge, *Ground-water management, *Model studies, *Geohydro-logy, Prediction, Optimization, Mathematical stud-ies, Reservoirs, Aquifers, Hydraulic.

Appropriately located recharge basins can contribute significantly to groundwater availability for pumping. Hydraulically desirable sites can be identified by hydrogeologic screening and by performing preliminary optimizations. These optimizations are performed without using recharge basins. Examination of resulting constrained derivatives identifies locations at which the availability of additional recharge would most greatly increase the total pumping volume. To develop optimal groundwater extraction strategies for systems that include recharge basins, it is desirable to utilize discrete kernels that describe the effect on water levels of pumping and interflow based on simultaneously pumping and interflow based on simultaneously existing groundwater and surface water heads. This assures that saturated interflow between reservoir and aquifer is modeled efficiently. Discrete kernels that accomplish this are presented. (Alexander IEEE) ander-PTT) W88-08061

POLYELECTROLYTE CHARACTERISTICS Pennsylvania State Univ., University Park. Dept. of Civil Engineering. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W88-08126

MODELS FOR THE DISSOLUTION OF CAR-BONATE ROCKS AND THE C13/C12 EVOLU-TION OF CARBONATE GROUND WATERS (MODELLE DER KALK-AUFLOESUNG UND C13/C12-ENTWICKLUNG VON KARBONAT-GRUNDWAESSERN).

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.

For primary bibliographic entry see Field 5C. W88-08145

OVERSHOOTING EFFECTS DUE TO HY-DRODISPERSIVE MIXING OF SALTWATER LAYERS IN AQUIFERS, Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Matematik und Mechanik.

M. Thiele, and H.J. Diersch.

Advances in Water Resources AWREDI, Vol. 9, No. 1, p 24-33, March 1986. 6 fig, 15 ref, 3 append.

Descriptors: *Saline water intrusion, *Aquifers, *Mathematical models, *Upconing, *Saline-freshwater interfaces, Overshooting, Hydrodispersive

In computation of saltwater intrusion processes transient effects involving an elevation of salinity above a final steady state occurs have been obabove a final steady state occurs have been ob-served and termed as 'overshooting'. The over-shooting phenomena was studied using a paradig-matic saltwater layer problem. An analytical solu-tion for 2-dimensional unsteady convective and hydrodispersive saltwater spreading in a bilayered aquifer. Good agreement was found between ana-lytical predictions and numerical results obtained by finite elements. Using the analytical solution, it was found that the major factors for the existence was found that the major factors for the existence and development of overshooting are the initial conditions of saltwater layering and the difference of the flow velocities between the layers. The results can provide better insight into the mixing process of flowing saltwater layers. (Author's ab-stract) W88-08176

3-D FINITE ELEMENT CONJUGATE GRADI-ENT MODEL OF SUBSURFACE FLOW AUTOMATIC MESH GENERATION,

Padua Univ. (Italy). Inst. of Applied Mathematics. G. Gambolati, G. Pini, and T. Tucciarelli. Advances in Water Resources AWREDI, Vol. 9, No. 1, p 34-41, March 1986. 12 fig. 5 tab, 21 ref.

Descriptors: *Model studies, *Flow nets, *Groundwater movement, *Mathematical models, Groundwater level, MAITHREE 3-dimensional flow model, Confined aquifers.

The 3-D (3-dimensional) flow modeling of ground-water systems of realistic size generally requires a big effort for the preparation of the input data as well as large computational costs. A numerical finite element model (MAITHREE) was developed for the efficient analysis of the steady and unsteady behavior of natural confined 3-D basins. stating from an initial triangular grid the code automatically generates a set of tetrahedral elements in each of the geologic units or subunits specified by the user in the vertical profile. The original element incidences list is the original element incidences list is then rearranged to provide conforming 3-D elements throughout the domain. The model was designed to save much of the labor involved in setting up a 3-D grid and to provide flexibility as well as economical con-venience through a high computational efficiency venience through a high computational efficiency. Convenience is achieved by using a solver based on the modified conjugate gradient (MCG) method which has proved to be an excellent method for the solution of large linear finite element sets of sparse 3-D subsurface equations. Some examples derived from both hypothetical and real-world situations are discussed to illustrate the innovative features of MAITHREE and its computational performance. (Author's abstract) W88-08177

COUPLING OF FINITE ELEMENT AND OPTI-MIZATION METHODS FOR THE MANAGE-MENT OF GROUNDWATER SYSTEMS, Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hy-

dromechanik. For primary bibliographic entry see Field 4B. W88-08187

DERIVATION OF BASIC EQUATIONS OF MASS TRANSPORT IN POROUS MEDIA: PART 1. MACROSCOPIC BALANCE LAWS, Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Leidschendam (Netherlands). For primary bibliographic entry see Field 5B.

DERIVATION OF BASIC EQUATIONS OF MASS TRANSPORT IN POROUS MEDIA: PART 2. GENERALIZED DARCY'S AND FICK'S LAWS.

Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Leidschendam (Netherlands). For primary bibliographic entry see Field 5B.

SUBGLACIAL HYDROLOGY FOR AN ICE SHEET RESTING ON A DEFORMABLE AQUI-

Simon Fraser Univ., Burnaby (British Columbia).
Dept. of Mathematics and Statistics.
For primary bibliographic entry see Field 2C.
W88-08233

MELT-WATER DRAINAGE PATTERN OF COMPOSITE GLACIERS,

Geologisches Landesam Nordrhein-West Krefeld (Germany, F.R.). For primary bibliographic entry see Field 2C. W88-08234 Nordrhein-Westfalen.

DISCHARGES OF TURBID WATER DURING MINI-SURGES OF VARIEGATED GLACIER, ALASKA, U.S.A.,

Washington Univ., Seattle. Geophysics Program N. Humphrey, C. Raymond, and W. Harrison. Journal of Glaciology JOGLAO, Vol. 32, No. 111, p 195-207, 1986. 6 fig. 2 tab, 28 ref. National Science Foundation, Division of Polar Programs, grants DPP-7903942 and 8200725.

Descriptors: *Glaciers, *Glaciohydrology, *Glacial surges, *Flow discharge, Variegated Glacier, Alaska, Seasonal variation, Diurnal variation, Velocity, Conduits, Glacial sediments, Turbidity, Velocity, Hydraulics.

Discharges of water, sediment, and dissolved im-purities from Variegated Glacier, Alaska, were monitored in the early summers of 1980 and 1981 during the occurrence of mini-surges. Seasonal trends, weather-related events, and diurnal variations, weamer-related events, and diurnal variations similar to behavior of other temperate glacier streams were found. The principal effect in the stream associated with mini-surge occurrence was a brief discharge of extremely turbid water. The a brief discharge of extremely turbid water. The turbidity is assumed to be introduced into the basal hydraulic system by initiation of the fast motion of a mini-surge at a time and location on the upper glacier known from other measurements. The mean water velocity in the hydraulic system over the intervening distance is thereby determined (0.3 m/s). The mean water velocity, together with the water discharge (16 cu m/s at the terminus), places constraints on the distribution of water velocity u and total cross-sectional area A-T of the flow paths along the glacier base. This leads to the conclusion that within the zone of mini-surge occurrence in its unperturbed state: u is about 0.1 m/s or possibly more, and it unperturbed state: u is about 10 m/s or possibly more, and it must be divided into a very large number of small passageway, be blocked by constrictions, or both. The total water cross-section corresponds to a layer 0.1-0.2 m thick when spread uniformly over the glacier width. The water velocity is close to or less than the prophetion velocity of the mini. the glacier width. The water velocity is close to or less than the prophagation velocity of the mini-surges. Between the zone affected by mini-surges and the streams, a dynamically less active lower section of the glacier is probably underlain by a small number of conduits, in which the water velocity may be very high (>2 m/s). Water dis-charge following the mini-surges puts an upper limit on water-storage changes associated with the anomalous ice motion. (Author's abstract) W88-08236

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SOME OBSERVATIONS ON SUBGLACIAL GROUND-WATER FLOW, University of Western Ontario, London. Dept. of

University of

Journal of Glaciology JOGLAO, Vol. 32, No. 111, p 232-234, 1986. 3 fig, 13 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Karst hydrology, *Groundwater movement, *Glacial sediments, *Sediment transport, *Drainage sys-tems, Conduits, Regelation water, Cavern flow, Hydraulics, Columbia Icefield, Canada, Sediments, Paleohydrology, Interglacial periods.

Conduit and regelation water are inferred to drain as ground water from up to 130 sq km of Columbia Icefield. Subglacial conduits appear to be generally occupied by free surface streams. Groundwater flow will allow exchange between the regelation film and conduits. Present-day discharge from beneath the accumulation zone carries little sediment, and past injections of sediment appear to correspond to ancient interglacials. Transport of sediment through cave passages may be analogous to transport through basal conduits. (Author's abstract) W88-08237

AMMONIUM TRANSFORMATIONS IN SPRINGWATER WITHIN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM, York Univ., Toronto (Ontario). Dept. of Geogra-

phy. For primary bibliographic entry see Field 5B. W88-08267

STUDIES OF THE INFILTRATION AND MI-GRATION OF BRINE IN POTASH TAILINGS. Saskatchewan Univ., Saskatoon. Dept. of Civil Eneering. For primary bibliographic entry see Field 5B. W88-08305

TRANSIENT SEEPAGE MODEL FOR SATURATED-UNSATURATED SOIL SYSTEMS: A GEOTECHNICAL ENGINEERING AP-

Saskatche wan Univ., Saskatoon. Dept. of Civil En

gineering. L. Lam, D. G. Fredlund, and S. L. Barbour. Canadian Geotechnical Journal COJOAH, Vol. 24, No. 4, p. 565-580, November 1987. 18 fig. 1 tab, 24 ref.

Descriptors: *Groundwater movement, *Soil water, *Simulation, *Seepage, *Flow systems, *Hydraulics, *Model studies, *Engineering, Seepage analysis, Permeability coefficient, Computer models, Aeration zone, TRASEE model, Satura-

A two-dimensional finite element model is proposed to simulate transient seepage for complex groundwater flow systems. The complete soil system is treated as a continuum encomp flow in both saturated and unsaturated zon system is treated as a continuum encompassing flow in both saturated and unsaturated zones. In the unsaturated zone, the air phase is assumed to be continuous and open to atmospheric pressure. The coefficient of permeability of the unsaturated soil is assumed to be a function of pore-water pressure. The governing differential equation is derived within a framework familiar to geotechnical engineers. The stress state variables and the constitutive relationships for an unsaturated soil are used in the derivation. The finite element solution to the governing differential equation is based on the Galerkin weighted-residual method. The nonlinearity of the equation is solved by iterative procedures. The finite element formulation is implemented into a computer model named TRASEE. The model can be applied to a wide variety of problems involving complex boundary conditions and geometries with arbitrary degrees of heterogeneity and anisotropy. Example problems are presented to demonstrate the capabilities of the model. The results indicate that the quantity of water flow in the unsaturated zone may be substantial, and that the phreatic line is not a flow line. It has been found that the traditional 'saturated-only' flow-net

technique can be approximated as a special case to the proposed saturated-unsaturated model. (Au-thor's abstract)

VADOSE ZONE CHARACTERIZATION OF LOW-PERMEABILITY SEDIMENTS USING FIELD PERMEAMETERS, New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience, D. B. Stephens, M. Unruh, J. Havlena, R. G. Knowlton, and E. Mattson. Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 59-66, Spring 1988. 6 fig, 3 tab, 14 ref.

Descriptors: *Hydraulic conductivity, *Reservoir sites, *Disposal sites, *Waste disposal, *Path of pollutants, *Groundwater movement, *Soil contamination, Vadose zone, Permeability, Seepage analysis, Hydrology, Saturation zone, Permeameters, Performance evaluation.

Measurement of the saturated hydraulic conductivity of material in the unsaturated zone beneath proposed surface impoundments is important for predicting seepage rates of water and contaminants. Hazardous waste disposal facilities are commonly sited on the basis of the low permeability of the geologic materials beneath the site. Field measurement of the saturated hydraulic conductivity of low-permeability materials may be accomplished using air-entry permeameters and borehole permeameters. The results of a coordinated field and laboratory investigation of low-permeability materials at a hazardous waste facility are presented. The different methods of testing and analysis are compared and discussed. In general, air-entry permeameters and borehole permeameters are useful for measuring the saturated hydraulic conductivity of low-permeability materials. (Author's abstract) W88-08310

MONITORING THE VADOSE ZONE IN FRAC-Earth Technology Corp., Long Beach, CA. For primary bibliographic entry see Field 7B. W88-08312 TURED TUFF,

FINITE ELEMENT MODELING OF FLOW IN A COAL SEAM WITH UNDERGROUND COAL GASIFICATION CAVITIES, Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics. For primary bibliographic entry see Field 5B. W88-08323

FORECASTING GROUNDWATER SUITABIL-ITY FOR IRRIGATION: A CASE STUDY IN THE NILE VALLEY, EGYPT, Vrije Univ., Amsterdam (Netherlands). Inst. voor

Aardwetenschappen.
For primary bibliographic entry see Field 4B.
W88-08330

ISOTOPE HYDROLOGY OF THE AGHIOS NI-KOLAOS AREA OF CRETE, GREECE, Democritos Nuclear Research Center, Athens

. L. Leontiadis, B. R. Payne, and T.

Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 121-132, March 15 1988. 6 fig, 2 tab, 13 ref.

Descriptors: *Available water, *Groundwater re-charge, *Coastal aquifers, *Water resources devel-opment, *Water yield, *Isotope studies, Aquifers, Springs, Recharge, Flow velocity, Tritium, Deute-rium, Oxygen-18, Crete, Greece, Groundwater

Deuterium and oxygen-18 data have been used to identify the origin of recharge to a coastal complex of springs and aquifers developed for supplying water to Aghios Nikolaos, Crete. Tritium data have been used to estimate the age of groundwater at different sampling locations. The results indicate that the Almyros Aghios Nikolaos springs are re-

charged mainly from the part of the Gavrovo-Tripolitza limestones forming the mountains of Selena, Katharo Tsivi and Lassithiotika, while the part of the same limestones forming the mountain-ous area of Mavro Dassos provides recharge to the northern part of the Aghios Nikolaos plateau. The Mavro Dassos area has a total surface area of 26.5 Mavro Dassos area has a total surface area of 20.5 as km, implying a potential mean annual recharge of 12,700,000 cu m; the total surface area involved in recharge of the Almyros Aghios Nikolaos springs is 127.8 sq km, implying a potential mean annual recharge of 88,600,000 cu m. The flow velocity of this water during the last few kilometers to the coast is 1 km/yr. (Hammond-PTT) W88-08331

DEUTERIUM AND OXYGEN-18 STUDIES IN GROUNDWATER OF THE DELHI AREA,

Panjab Univ., Chandigarh (India). Centre of Ad-

vanced Study in Geology.

B. K. Das, Y. P. Kakar, H. Moser, and W. Stichler.
Journal of Hydrology JHYDA7, Vol. 98, No. 1/2,
p 133-146, March 15 1988. 7 fig. 1 tab, 18 ref.

Descriptors: *Groundwater movement, *Tracers, *Water chemistry, *Salinity, *Groundwater recharge, *Isotope studies, *Chemical properties, Meteoric water, Precipitation, Rainfall, Evaporation, Soil type, Monsoon, Recharge, Deuterium, Oxygen isotopes, India, Yamuna River, Arabian Sea, Irrigation effects, Infiltration.

Sea, Irrigation effects, Infiltration.

Groundwater in the Delhi area occurs under different hydrogeological conditions: west of the Delhi Ridge, closed basin of Chattarpur, between the Ridge and the Yamuna River and east of the Yamuna River with depth to the water table ranging from 1.53 to 19.12 m below ground level. A comparison of isotopic data of groundwater with that of rainfall (during the period 1961-78) indicates that groundwater in all the subbasins and at different depths is of meteoric origin having undergone direct evaporation and is genetically similar. Deviation of the points from the meteoric line on a D-oxygen-18 diagram is attributed to evaporation from falling rain drops and retardation in infiltration rate of rainwater, which is due to the predominance of clayey soils at several places. The major sources of high salinity are the high rate of evaporation, recycling of irrigation water, and re-solution of precipitated minerals by monsoon recharge along with nonflushing of deeper waters. This is contrary to the findings of earlier workers who proposed that the high salinity of groundwater is related to marine origin and/or fallout of airborne salts from the Arabian Sea. (Author's abstract) W88-08332

HYDROCHEMISTRY AND GROUNDWATER SYSTEM OF THE ZERKA MA'IN-ZARA THER-MAL FIELD, JORDAN, Jordan Univ., Amman. Water Research and Study

Center.

O. Rimawi, and E. Salame Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 147-163, March 15 1988. 5 fig, 9 tab, 27 ref.

Descriptors: "Groundwater movement, "Recharge, "Chemical properties, "Model studies, "Thermal water, Springs, Temperature, Carbon dioxide, Minerals, Sandstones, Dead Sea, Zerka Ma'in-Zara, Jordan, Thermal springs, Paleohydrology, Aquifers logy, Aquifers.

A groundwater flow model through the different geological successions from the Upper Cretaceous through the Lower Cretaceous sandstone and through the Lower Cretaceous sandstone and older units is presented. The model is supported by the hydrochemical evolution of water types from the recharge areas in the highlands to discharge sites of thermal water at the slopes overlooking the Dead Sea. The thermal water discharged in the Zerka Ma'in-Zara areas consists of three end members mixed in different ratios with a component of old (many thousands of years) thermal water undersaturated in carbonate minerals and contain dersaturated in Carbonate inherats and Containing hundreds of milligrams per liter of free CO2. The release of CO2 gas upon discharge renders the water oversaturated with respect to carbonate min-

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erals which results in aragonite precipitation. The elevated temperature of the water in the reservoir (73-82 C) is attributed to the presence of a heatstoring layer topping the aquifer. (Author's abstract) W88-08333

INTEGRATED APPROACH TO AQUIFER DE-LINEATION IN HARD ROCK TERRAINS: A CASE STUDY FROM THE BANDA DISTRICT, INDIA.

Roorkee Univ. (India). School of Hydrology. D. C. Singhal, S. Niwas, and B. B. S. Singhal. Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 165-183, March 15 1988. 9 fig, 3 tab, 36 ref.

Descriptors: *Available water, *Groundwater potential, "Aquifer characteristics, "Geohydrology, Electrical sounding, Computer analysis, Mapping, Banda District, India, Sandstone aquifers, Bedrock.

For obtaining a quick and stable solution of a groundwater problem in a hard rock area, totalling about 3000 square km in the southeastern parts of the Banda district of India, an integrated approach of photogeological, hydrogeological and geoelectrical studies was carried out with satisfactory results. The data of 160 vertical electrical soundings were interpreted using a computer oriented tideswere interpreted using a computer oriented ridge-regression estimation technique, which provided a stable solution of the resistivity inverse problem stable solution of the resistivity inverse problem even when the data are inaccurate and system parameters are linearly dependent. The integrated studies have indicated the existence of three aquifers in the subsurface: (1) a porous, sandy aquifer within the alluvium; (2) fractured (and weathered) aquifers in the sandstone bedrock in the eastern and southern parts, and in the granite bedrock in the northwestern parts of the area; and (3) a decers aquifer; in the caserous delomite. (3) a deeper aquifer in the cavernous dolomite, occurring below the compact sandstones, and expected to be highly productive at a number of localities. However, its southward extension beyond a lineament, designated as Manikpur Shear Zone, could not be established. (Author's abstract) W88-08334

IMPROVED NUMERICAL SOLUTION FOR THE DIFFUSION EQUATION,

Halland County Administrative Board, Halmstad

G. N. Bakkes, and J. F. Botha.

Advances in Water Resources AWREDI, Vol. 10, No. 1, p 21-31, March 1987. 10 fig, 1 tab, 7 ref, 1

Descriptors: *Groundwater movement, *Aquifers, Diffusion equation, *Flow equation, *Hydrodynamics, Boreholes, Computer models, Mathematical models, Galerkin method, Numerical analysis.

This paper is concerned with the application of the two-dimensional Galerkin approximation to the modelling of the dynamic groundwater flow equation. Attention is paid to a problem almost universally encountered in the modelling of these problems: the singularities caused by the presence of sources and/or sinks in the domain of interest. One method to improve the solution of the dynamic flow equation page hospholes it to envirge the flow equation near boreholes is to subtract the singular behavior of flow with a time-dependent analytic solution for near-boreholes zones. By sub-tracting the singularities in this way, the resulting smooth problem may be solved by the Galerkin method and the result can be combined with the analytic solutions. The result is an improved solu-tion near boreholes without the need to use a refined mesh and thus a saving in computer storage and time. (Author's abstract) W88-08337

STEADY TWO- AND THREE-DIMENSIONAL FLOW FROM SATURATED TO UNSATURAT-

Arizona Univ., Tucson. Dept. of Soil and Water

For primary bibliographic entry see Field 2G. WRR-08341

MISCIBLE FLOW THROUGH POROUS MEDIA WITH DISPERSION AND ADSORP-

Universidad Nacional de La Plata (Argentina). S. C. Gabbanelli, C. A. Grattoni, and M. S. Bidner. Advances in Water Resources AWREDI, Vol. 10, No. 3, p 149-158, September 1987. 5 fig, 14 ref, 2

Descriptors: "Groundwater movement, "Soil physics, "Mixing, "Soil water, "Porous media, "Fluid flow, "Finite difference method, "Adsorption, "Dispersion, Mathematical analysis, Differential equations, Boundary conditions, Optimization.

In this paper, multicomponent single-phase flow through porous media is found in many technologi-cal problems of petroleum engineering, chemical engineering and hydrology such as: oil recovery miscible displacement processes, ion exchange colengineering and hydrology such as: oil recovery miscible displacement processes, ion exchange columns, fixed-bed chemical reactors, soil physics and groundwater flow. The partial differential nonlinear equation which describes the one-dimensional flow of miscible fluids through porous media with dispersion and Langmuir equilibrium adsorption is numerically solved by finite differences. Local truncation error is determined and von Neumann stability analysis is applied. In order to eliminate either numerical dispersion or unstability, weighing parameters and distance and time increments are conveniently adjusted. Finite differences results are verified with the exact solution for the linear adsorption case. They are obtained for difsults are verified with the exact solution for the linear adsorption case. They are obtained for different boundary conditions, whose influence is discussed. Numerical solutions are matched with experimental results from Szabo's polymer flooding tests. Differences between numerical and experimental results are minimized applying optimization techniques to obtain the most suitable physical parameters. (Author's abstract)
W88-08348

WATER TABLE DRAWDOWN FOR TWO-DI-MENSIONAL DRAINAGE, Thessaloniki Univ., Salonika (Greece). Dept. of

Rural Engineering. For primary bibliographic entry see Field 4B. W88-08349

COMBINING PHYSICAL CONTAINMENT WITH OPTIMAL WITHDRAWAL FOR CONTAMINATED GROUNDWATER REMEDI-

For primary bibliographic entry see Field 5G. W88-08353

SIMULATION OF DENSITY STRATIFIED FLOWS IN AQUIFERS, Technion - Israel Inst. of Tech., Haifa. Faculty of

Civil Engineering.
H. Rubin, and Y. Rubin.
Advances in Water Resources AWREDI, Vol. 9,
No. 1, p 2-15, March 1986. 11 fig, 3 tab, 9 ref.

Descriptors: *Aquifers, *Groundwater movement, *Hydrodynamics, *Flow characteristics, *Density, *Stratified flow, Simulation analysis, Mathematical models, Algorithms, Saline water, Boundary

A simple method is suggested for regional simulation of flow conditions in a leaky aquifer originally consisting of a deep layer saturated with saline water and an upper layer saturated with freshwater. The model proposed assumes that three different zones develop in the aquifer subject to utilization: (a) freshwater zone, (b) transition zone, and (c) saline water zone. In zones (a) and (c) the potential flow theory is applied. It is assumed that the nonpotential flow in zone (b) can be represented by the integral similarity model of boundary layers. For the simulation, a numerical finite difference in the supplied of the supplied in the supplied to the simulation. layers. For the simulation, a numerical finite difference scheme is used. This scheme is based on the Half Time Step Algorithm being developed in this study. Numerical experiments provide the means demonstrating possible effects of the parameters involved in transport processes through the aquifer. The numerical scheme is found to be very stable, it converges rapidly and uses small quanti

ties of computer time and memory. (Author's abstract) W88-08358

NUMERICAL ERRORS ASSOCIATED WITH THE ITERATIVE ALTERNATING DIRECTION IMPLICIT (IADI) FINITE DIFFERENCE SO-LUTION OF THE TWO DIMENSIONAL TRAN-SIENT SATURATED-UNSATURATED FLOW

KEICHARDS) EQUATION,
Imperial Coll. of Science and Technology, London
(England). Dept. of Civil Engineering.
G. A. Parissopoulos, and H. S. Wheater.
Hydrological Processes HYPRE3, Vol. 2, No. 2, p
187-201, April 1988. 9 fig, 4 tab, 22 ref.

Descriptors: *Saturated flow, *Unsaturated flow, *Finite difference methods, *Groundwater movement, *Flow equation, *Groundwater recharge, *Infiltration, *Water table, *Hydraulic conductivity, Error analysis.

Numerical models for simulation of multidimensional unsaturated flow are becoming increasingly available, but relatively little has been reported on the detailed analysis of numerical errors associated with such schemes. For unsaturated-saturated flow, further complexity is introduced to the highly non-linear unsaturated problem as the form of governing equation changes within the flow field. A two-dimensional simulation of infiltration to a water table is considered. Numerical errors associated with selection of time step, grid geomeassociated with selection of time step, grid geomeassociated with selection of time step, gran geome-try, convergence criteria, and the representation of internodal hydraulic conductivity are discussed with respect to moisture content profiles and mass balance error. Although solution sensitivity to nunature error. Although solution sensitivity to nu-merical parameters is problem specific, the results indicate the nature and magnitude of numerical effects which should not be overlooked in model applications. (Author's abstract) W88-08371

FACTORS INFLUENCING ENTRY OF PESTI-CIDES INTO SOIL WATER,

Rothamsted Experimental Station, Harpenden (England).

For primary bibliographic entry see Field 5B. W88-08374

GROUND-WATER FLOW MODEL OF THE CORNING AREA, NEW YORK,

Susquehanna River Basin Commission, Harrisburg,

Susquehanna River Basin Commission, Harrisburg, PA. Publication No. 116, March 1988. 127 p, 24 fig, 12 tab, 25 ref, append.

Descriptors: *Groundwater *Groundwater move-ment, *Model studies, Corning, New York, Strati-fied flow, Aquifers, Flow profiles, Permeability coefficient, Transmissivity, Groundwater budget, Groundwater depletion, Groundwater mining.

A quasi-three-dimensional finite-difference model of groundwater flow has been developed for strati-fied drift aquifers in the area around Corning, New York. The aquifer system consists of a surficial outwash aquifer that is permeable, areally extensive and hydraulically connected to surface streams but has only a small saturated thickness over most of the valley. Groundwater withdrawals in the area around Corning totaled an estimated 10.2 mgal/d in 1980. The model is used to simulate 10.2 mgal/d in 1980. The model is used to simulate horizontal flow in two layers; the upper layer represents the surficial aquifer and is unconfined, and the lower layer generally represents the buried aquifer and is confined. Vertical flow is simulated between these layers through beds of silt and clay where present or through sand and gravel. Horizontal hydraulic conductivities of the sand and gravel range from 100 to 800 ft/d in the calibrated codel. It representativities in the confined course. gravel range from 100 to 500 It/d in the calibrated model; transmissivities in the confined aquifer range from 42,300 sq ft/d to 27,000 sq ft/d in areas tapped by production wells. The steady-state model was used to simulate average conditions with current levels of groundwater withdrawals, 'natural' non-pumping conditions, and a hypotheti-

Groundwater-Group 2F

cal drought similar to the extended dry period in the 1960's. The transient simulation demonstrates the sensitivity of the groundwater system to small changes in river stages. If more detailed transient simulation are desired, then further adjustments to storage coefficients are recommended. (Author's

GROUND-WATER RESOURCES OF THE CHE-MUNG RIVER BASIN, NEW YORK AND PENNSYLVANIA, Susquehanna River Basin Commission, Harrisburg,

For primary bibliographic entry see Field 4B. W88-08397

TRANSPORT OF ORGANIC CONTAMINANTS IN COASTAL PLAIN SEDIMENTS, Savannah River Lab., Aiken, SC. Environmental Sciences Div. For primary bibliographic entry see Field 5B. W88-08417

GROUND WATER,
Massachusetts Inst. of Tech., Cambridge. Dept. of
Chemistry.
H. M. Raghunath.
Second Edition. John Wiley and Sons, New York.

Descriptors: *Groundwater, *Geohydrology, *Groundwater movement, Flow profiles, Mathematical studies, Saline water intrusion, Mathematical equations, Field tests, Aquifers.

Surface water resources may become short of supply or may not be easily available at site. Groundwater commonly occurs and is widely distributed. There has been an increase in groundwater development and utilization, particularly in developing countries for agriculture, industry, industry. reduced. Here mis ocen an increase in groundwater development and utilization, particularly in developing countries, for agriculture, industry and nural water supply schemes. An attempt is made to introduce all the aspects of groundwater - its assessment, development, utilization and management. The information on different topics which is usually found scattered in various technical books, journals and seminar volumes has been pooled with an emphasis on basic principles and without enlarging on the derivation of the formulae. The practical application of the different formulae for the field conditions, data collection and processing, test procedures and principles of design are elaborated and actual field problems are worked out to illustrate the theory and the design procedure. Special cases of groundwater flow by the method of images, one- and two-dimensional flows, numerical analysis, Glover's method for seawater intrusion, etc. have been included. (Lantz-PTT)

REGIONAL GROUND-WATER FLOW NEAR RICHTON AND CYPRESS CREEK DOMES, MISSISSIPPI: ANNUAL STATUS REPORT FOR FISCAL YEAR 1984.
Earth Technology Corp., Long Beach, CA. Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011006. Price codes: A10 in paper copy, A01 in microfiche. Battelle Memorial Institute Report No. BMI, ONWI-640, June 1987. Technical Report. 222 p, 78 fig. 20 tab, 111 ref. DOE Contract No. DE-AC02-83CH10140.

Descriptors: *Radioactive waste disposal, *Salt domes, *Hydrologic models, *Groundwater move-ment, *Mississippi, Richton Dome, Cypress Creek Dome, Mathematical models, Hydrologic data, Numerical analysis, Computer programs

The reported work is part of an ongoing evalua-tion of Richton and Cypress Creek salt domes, located in Perry County, Mississippi, as potential repositories for high-level nuclear waste. This report describes the refinement of previously de-veloped conceptual and numerical models of region groundwater flow in the vicinity of the domes, based on extensive evaluation of all avail-able hydrologic data and on application of a com-

puter flow code. This report summarizes the hydrologic data used to refine the conceptual model, characterizing model boundary conditions and determining best estimates and bounds of reasonable certainty for hydraulic properties and flow in the major hydrogeologic units. Refined inputs were applied to the numerical model for calibration GRAM, a three-dimensional, finite-element flow code, was used for numerical modeling. The numerical model, calibrated to measure water levels, calculated fluxes and water budgets by applying parameter estimation by least squares regression. A two-dimensional vertical slice model aided in calibrating the three-dimensional regional groundwater flow model. The report describes the calibration procedure and assesses the resulting model. The er flow model. The report describes the calibration procedure and assesses the resulting model. The results of the data evaluation and the computer code application are described with emphasis on best estimates and bounds of reasonable certainty for groundwater flow parameters in the regional model area and on behavioral aspects of the groundwater flow system. The refined conceptual and numerical models of regional groundwater flow described in this report are not considered final. Potential work to further refine the models is outlined in the final section of the report. (Author's abstract) abstract) W88-08511

GEOSTATISTICS APPLIED TO GROUNDWAT-ER CONTAMINATION. I: METHODOLOGY, South Florida Water Management District, West Palm Beach. Dept. of Resource Management. For primary bibliographic entry see Field 5A. W88-08569

GEOSTATISTICS APPLIED TO GROUNDWAT-ER CONTAMINATION, II: APPLICATION, South Florida Water Management District, West Palm Beach. Dept. of Resource Management. For primary bibliographic entry see Field 5A. W88-08570

DYNAMICS OF A TROPICAL FLOODPLAIN ENVIRONMENT WITH REFERENCE TO FOREST ECOLOGY,

Bristol Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 2A. W88-08603

STUDIES ON THE MOTION OF GROUND WATER WITH DISPERSION IN COASTAL AQUIFERS: III. DISPERSIVITIES IN NAKA RIVER AND KIKI RIVER ESTUARIES, (IN JAPANESE).

Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
T. Kakinuma, Y. Kishi, K. Inouchi, and K.

Tsuzuki. Japanese Journal of Limnology RIZAA, Vol. 48, No. 1, p 33-39, January 1987. 13 fig, 6 ref.

Descriptors: *Model studies, *Groundwater move-Descriptors: "Model studies, "Cronindwater move-ment, "Coastal aquifers, "Confined aquifers, En-roachment, "Saline water intrusion, "Naka River, Kiki River, Estuaries, Seawater, Mathematical analysis, Piezometers, Dispersion model, Enroach-

A three-dimensional steady state hydrodynamic dispersion model with a velocity-dependent dispersion coefficient was used to simulate seawater encroachment in the confined aquifers in the estuaries of the Naka River. Tokushima Prefecture, and the Kiki River, Ehime Prefecture, Japan. The main results are as follows: 1) The longitudinal and lateral dispersivities are 1,000 to 1,250 m and 100 to 125 m in the estuary of the Naka River, respectively. In the estuary of the Naka River, the corresponding values are 200 m and 200 to 20 m, respectively. 2) Examining the local distribution of the dispersion coefficient values computed from the dispersivity and velocity fields of groundwater, the same value estimated in the analysis with the constant dispersion coefficient is located in the constant dispersion coefficient is located in the middle layer of the aquifer. 3) In the estuary of the Naka River, the piezometric surface predicted using the dispersion model with the velocity-de-pendent dispersion coefficient is almost the same as

the one predicted with the dispersion model with the constant dispersion coefficient. They are 5 to 10% lower than the one predicted with an inter-face model, but about 1.32 times higher than the observed one. (Author's abstract) W88-08632

STUDIES ON THE MOTION OF GROUND WATER WITH DISPERSION IN COASTAL AQUIFERS: IV. NUMERICAL ANALYSIS BASED ON TWO-DIMENSIONAL UNSTEADY STATE MODEL, (IN JAPANESE),

Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.

T. Kakinuma, Y. Kishi, K. Inouchi, and K. Tsuzuki.

Japanese Journal of Limnology RIZAA, Vol. 48, No. 2, p 99-109, April 1987. 15 fig, 13 ref.

Descriptors: *Groundwater movement, *Coastal aquifers, *Confined aquifers, *Tidal effects, *Saline water intrusion, Mathematical models, Enroach-

An unsteady state two-dimensional hydrodynamic An unsteady state two-dimensional nytordynamic dispersion model was used to simulate seawater intrusion into confined coastal aquifers in response to the tide and to a sudden change in discharge of groundwater in the upstream region. Salt water intrudes farthest inland at mean sea level in the ebb tide stage, as in the case of the fresh-salt water interface model of Kishi and Inouchi; the transition zone from fresh water to salt water becomes widest at that sea level. The movement of the sucden change in groundwater discharge retreats faster than it advances; the movement is compara-ble with the fresh-salt water interface movement computed by the interface mode of Kakinuma et al. The concentration distribution in response to the tide computed with the higher values of the storage coefficient of the confined aquifer is somestorage coefficient. (Author's abstract)

W88-8637

MOTION OF COASTAL CONFINED GROUND-WATER IN THE PRESENCE OF VARIOUS PATTERNS OF PUMPING: II. NUMERICAL ANALYSIS BY THE STEADY STATE DISPER-SION MODEL, (IN JAPANESE), Ehime Univ., Matsuyama (Japan). Dept. of Ocean

Engineering. T. Kakinuma, Y. Kishi, and K. Inouchi. Japanese Journal of Limnology RIZAA, Vol. 48, No. 4, p 265-274, December 1987. 13 fig, 1 tab, 13

Descriptors: "Groundwater management, "Groundwater movement, "Coastal aquifers, "Saline-freshwater interfaces, "Saline water introsion, Confined aquifers, Confined groundwater, Numerical analysis, Pumping, Mathematical words."

A two-dimensional steady state hydrodynamic dis-persion model was used with a fresh-salt water interface model to investigate the motion of coastal interface model to investigate the motion of coastal confined groundwater in the presence of various pumping patterns. Two expressions of the dispersion coefficient were considered; one is constant over the entire region of the aquifer, and the other is dependent on the flow velocity of the groundwater. As the groundwater is pumped inland, salt water intrudes further inland, whereas pumping in the lower layer of the aquifer near the coast is effective in presenting seawater intrusion. In unpreeffective in preventing seawater intrusion. In upper layer pumping, the fresh-salt water interface model serves as a convenient method for approximate analyses and predictions of seawater intrusion into the coastal confined aquifers. (Author's abstract) W88-08650

MODEL ANALYSIS OF THE TRANSPORT OF SOLUTES IN SATURATED AND UNSATURATED DOMAINS, (IN JAPANESE),

Group 2F—Groundwater

Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering. For primary bibliographic entry see Field 5B. W88-08651

IMPORTANCE OF KEEPING GOOD WELL PERFORMANCE RECORDS, For primary bibliographic entry see Field 7B. W88-0655.

SEQUENTIAL ESTIMATION OF AQUIFER

PARAMETERS,
Westinghouse Hanford Co., Richland, WA.
A. H. Lu, F. Schmittroth, and W. W.-G. Yeh.
Water Resources Research WRERAO, Vol. 24,
No. 5, p 670-682, May 1988. 8 fig, 1 tab, 28 ref.

Descriptors: *Mathematical studies. *Aquifer char-Least-inpurs: "Mantematical studies, "Aquifer Char-acteristics, "Geohydrology, "Groundwater move-ment, Finite element method, Estimating equa-tions, Least squares method, Algorithms, Hydrolo-gy, Radioactive waste disposal, Pumping.

A two-dimensional 'inverse' or 'parameter estima-tion' code was developed for use in the Basalt Waste Isolation Project site characterization pronon code was developed for use in the Basalt Waste Isolation Project site characterization program. This project is investigating the feasibility of using a sequence of Columbia River basalts beneath the Hanford Site in south-central Washington as a repository for the permanent storage of high-level nuclear wastes. The method uses a sequential least squares algorithm that incorporates a finite element groundwater flow code. Adjoint equations and flow equations are formulated to include sequentially the output information for updating a priori parameter estimates. Several cases were studied to demonstrate the methodology developed; included were an analysis of pumping from a single well and a sequential analysis in which results obtained by pumping from one well were combined with an analysis of pumping from a second well. The approach emphasizes the sequential nature of the problem whereby the characterization of site hydrology can be systematically improved. (Author's abstract)

NEW ANALYTIC FUNCTION FOR MODEL-ING PARTIALLY PENETRATING WELLS,

Indiana Univ., Bloomington. School of Public and

Environmental Affairs.

H. M. Haitjema, and S. R. Kraemer.

Water Resources Research WRERAO, Vol. 24, No. 5, p 683-690, May 1988. 5 fig, 1 tab, 11 ref,

Descriptors: *Mathematical analysis, *Mathematical models, *Geohydrology, *Wells, *Groundwater movement, *Partially penetrating wells, Flow pattern, Groundwater pollution, Regional analysis, Aquifers.

A new analytic function were developed to model three-dimensional flow near a partially penetrating well. The function represents a sink distribution along the well axis, whereby equipotential conditions along the well perimeter are approximately satisfied by adjusting several degrees of freedom of the function. This procedure is well known and has led to rather accurate solutions provided a sufficient number of free parameters were incorporation achieves the same accuracy as past solutions with a significant reduction in the number of degrees of freedom required and hence fewer equations to be solved. This increased efficiency is of little consequence when the well is modeled by itself. However, when combined with the solutions to the many other flow features in a regional to the many other flow features in a regional aquifer, the savings become significant. In fact, if each of the individual solutions would have many degrees of freedom, the resulting system of equations may become unmanageable, thus restricting applications. To demonstrate the use of the new function, a hypothetical groundwater contractions. applications. To demonstrate the up to the function, a hypothetical groundwater contamina-tion problem is solved, whereby contaminants are intercepted by a partially penetrating well. (Au-thor's abstract)

DEPENDENCE OF ANISOTROPY ON SATURATION IN A STRATIFIED SAND,

RATION IN A STRATIFIED SAND, New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience. D. B. Stephens, and S. Heermann. Water Resources Research WRERAO, Vol. 24, No. 5, p 770-778, May 1988. 13 fig. 1 tab, 13 ref. U.S. Dept. of Interior, Geological Survey, Grant 14-08-0001-61956.

Descriptors: *Anisotrophy, *Saturation, *Soil water, *Stratification, *Sand, *Infiltration, *Unsaturated flow, Dye releases, Tensiometers, Steady flow, Permeability coefficient, Hydraulic gradient, Stratified flow, Saturated soils, Seepage, Discharge

A laboratory experiment was performed to investi-gate the movement of water infiltration from a point source into a porous medium comprised of alternating layers of fine and coarse sand placed in a clear plastic tank. The purpose of the experiment was to demonstrate whether the effective anisotrowas to demonstrate whether the effective anisotropy of stratified materials is dependent upon saturation. The noncolinearity of the specific discharge and hydraulic head gradient directions was used as a measure of anisotropy. Dyes were used to map the specific discharge direction and tensiometers were used to characterize the hydraulic gradient field under unsaturated, steady state conditions. The results indicate a divergence between the direction of the specific discharge and gradient which increases as the pressure head decreases. Anisotropy determined from the experiment exceeds that calculated from the hydraulic conductivities of the individual materials. (Author's abstract) stract) W88-08670

MICROBIAL ECOLOGY OF A SHALLOW UN-CONFINED GROUND WATER AQUIFER POL-LUTED BY MUNICIPAL LANDFILL LEACH-

ATE, Oklahoma Univ., Norman. Dept. of Botany and Okianoma Children Microbiology.
Microbiology.
For primary bibliographic entry see Field 5C.

LEACHING OF SILICA AND URANIUM AND OTHER QUANTITATIVE ASPECTS OF THE LITHOBIONTIC COLONIZATION IN A RA-DIOACTIVE THERMAL SPRING, Katholieke Univ. Nijmegen (Netherlands). Lab. of Exobiology.

For primary bibliographic entry see Field 2K. W88-08803

APPLICATION OF THE FINITE ELEMENT GROUNDWATER MODEL FEWA TO A RADIOACTIVE WASTE DISPOSAL SITE, Oak Ridge National Lab., TN. Environmental Sciences Div. For primary bibliographic entry see Field 5B. W88-08848

UNACCOUNTED-FOR WATER - A GROUND-WATER RESOURCE (L'EAU NON COMPATI-BILISEE - UNE SOURCE D'EAUX SOUTER-

Birmingham Univ. (England). Dept. of Geological For primary bibliographic entry see Field 4B. W88-08924

GROUNDWATER GRANITIC IN SAND GROUNDWATER IN GRANITIC SAND UNDER A COVERING OF SILTY CLAY AND ORGANIC MATTER - CRISTALLINE ROCKS OF THE HIGH PLATEAUS OF MADAGASCAR (AQUIFERE D'ARENES GRANITIQUES SOUS RECOUVREMENT ARGILO-LIMONEUX ET ORGANIQUE - HAUTS PLATEAUX CRISTAL-LOPHYLLIENS MADAGASCAR), Montpellier-2 Univ. (France). Lab. d'Hydrogeolo-

gie.
J. Grillot, and M. Raunet.
Comptes Rendes de l'Acadamie des Sciences
(Series 2) CHDCAQ, Vol. 306, No. 9, p 611-614,
March 1988. 2 fig, 5 ref.

Descriptors: *Groundwater, *Organic matter, *Water table, *Mineralization, *Silt, *Sand, *Granics, *Madagascar, Hydraulics, Mineralized groundwater, Rice fields.

Artificial pressure head provoked by surface waters in rice fields separated from an underlying granitic sandy aquifer by a clay and organic bed, was used to characterize the groundwater behavior according to its water table fluctuations. It is shown that groundwater is semi-confined with a good ability to store. This occurrence of water and mineral leakage can be assumed between the upper rice zone (rice roots zone), the organic bed and the mineralized groundwater. (Author's abstract) W88-08959 W88-08959

2G. Water In Soils

HYDRAULIC CONDUCTIVITY OF A SANDY SOIL AT LOW WATER CONTENT AFTER COMPACTION BY VARIOUS METHODS, Geological Survey, Menlo Park, CA. Water Resources Div.

J. R. Nimmo, and K. C. Akstin. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 303-310, March-April 1988. 11 fig, 3 tab, 33 ref.

Descriptors: *Hydraulic conductivity, *Compaction, *Soil mechanics, *Soil compaction, *Soil water, *Permeability coefficient, Hydrology, Model studies, Porosity, Sand, Capillarity, Capillary conductivity, Pore size.

lary conductivity, Pore size.

To investigate the degree to which compaction of a sandy soil influences its unsaturated hydraulic conductivity K, samples of Oakley sand (now in the Delhi series; mixed, thermic, Typic Xeropsamments) were packed to various densities and K was measured by the steady-state centrifuge method. The air-dry, machine packing was followed by centrifugal compression with the soil wet to about one-third saturation. Variations in (i) the impact frequency, (ii) the impact force during packing, and (iii) the amount of centrifugal force applied after packing, produced a range of porosity from 0.333 to 0.380. With volumetric water content theta between 0.06 and 0.12, K values were between 7 x 10 to the minus 11 power and 2 x 10 to the minus 8 power mis. Comparisons of K at a single theta value for samples differing in porosity by about 3% showed as much as fivefold variation for samples prepared by different packing procedures, while there generally was negligible variation (within experimental error of 8%) where the porosity difference resulted from a difference in centrifugal force. Analysis involving capillarytheory models suggests that the differences in K can be related to differences in pore-space geometry inferred from water retention curves measured for the various samples. (Author's abstract) for the various samples. (Author's abstract) W88-07984

SPATIAL VARIATION OF PARAMETERS DE-SCRIBING SOIL SURFACE ROUGHNESS, Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. G. A. Lehrsch, F. D. Whisler, and M. J. M.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 311-319, March-April 1988. 4 fig, 6 tab, 19

Descriptors: *Infiltration, *Roughness, *Soil surfaces, *Soil mechanics, *Soil water, Soil profiles, Hydrology, Mathematical studies, Spatial distribution, Simulated rainfall, Rainfall, Runoff rates, Soil erosion, Plant growth, Soy beans.

Soil surface roughness, the configuration of the soil Soil surface roughness, the configuration of the soil surface, affects infiltration, runoff velocities, erosion, and plant establishment and growth. One difficult aspect of studying surface roughness is that parameters describing roughness vary spatially. Eight roughness parameters were identified as possible indices of soil surface roughness. They were maximum peak height, maximum depression depth, peak frequency, the ratio of peak frequency to peak height, microrelief index (the area per unit

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transect length between the measured surface profile and the least-squares regression line through the measured elevations of the transect), the ratio of microrelief index to peak height, the ratio of microrelief index to peak height, the ratio of microrelief index to peak frequency, and lastly the product of the microrelief index and peak frequency (the MIF parameter). The objective of the study was to determine the spatial variation of the eight indices using a semi-variogram analysis. An automated, noncontract profiler was used to obtain surface profiles along transects 5 cm apart of 1-m by 1-m plots after a cultivation and a simulated rainfall application at each of three different stages of soybean (Glycine max (L.)) development. For each cultivation, surface profiles were obtained on bare plots before rainfall and on adjacent vegetated plots after rainfall. None of the eight indices commonly showed spatial dependence. When a roughness parameter was spatially dependent, however, its semi-variogram usually was spherical, linear with a nugget constant, or exhibited a hole effect. Across all plots on which they were found to be spatially dependent, the indices exhibited zones of influence averaging from 15 to 20 cm. (Author's abstract) W88_07985

INFILTRATION, MACROPOROSITY, AND MESOPOROSITY DISTRIBUTIONS ON TWO FORESTED WATERSHEDS, Oak Ridge National Lab., TN. Environmental Sci-

ences Div. G. V. Wilson, and R. J. Luxmoore. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 329-335, March-April 1988. 5 fig, 3 tab, 30

Descriptors: *Forest watersheds, *Porosity, *Infiltration rate, *Infiltration, *Soil water, *Soil mechanics, *Macroporosity, Stochastic process, Statistical methods, Mathematical studies, Hydrology, Model studies, Rainfall, Spatial distribution, Storm

Macro- and mesopore processes substantially control the subsurface flow in forested watersheds. Limited field scale information is available on spatial variability of macropore infiltration and associated porosity of the hydrologically active macroand mesopores. The double-ring and tension infiltrometer methods were employed at 37 and 39 locations. and mesopores. The double-ring and tension infil-trometer methods were employed at 37 and 39 locations, respectively, on two contrasting forested watersheds. The spatial variability of infiltration under ponded-flow (macropore-flow) and using 2, 5-, and 14-cm water tension (mesopore-flow) con-ditions was determined. The frequency distribu-tions were tested for lognormality with the Sha-piro-Wilk omega-statistic and with isopleth proba-bility analysis, and spatial dependence of these data was tested with semivariogram analysis. The infil-tration rates were found to be lognormally distrib-uted, with the mesopore infiltration rates as vari-able (coefficients of variation of 102-184%) as the macropore infiltration rates (coefficient of varia-tion of 107%). Macropore flow constituted 85% of the ponded flux; however, the mesopore fluxes were large and were considered sufficient to infil-trate rainfall without macropores filling and con-tributing to the flow. The large measured infiltra-tion rates were associated with exceedingly small macroporosities of 0.0003 cu m/cu m for Walker Branch Watershed and 0.0002 cu m/cu m for Melton Branch Watershed, respectively. The re-duction in infiltration rate with increased tension was described as a exponential function of the diameter of the largest effective pore. Semivario-grams revealed no spatial dependence for separa-tion distances > 4 m at Walker Branch Watershed. Infil-tration into these forested watersheds can be con-sidered a stochastic process for hydrologic model-ing. (Author's abstract) W88-07986

ALGORITHM FOR THE CALCULATION OF DRAIN SPACINGS FOR LAYERED SOILS, Polish Academy of Sciences, Lublin. Inst. Agrofizyki. R. T. Walczak, R. R. Van der Ploeg, and D.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 336-340, March-April 1988. 2 fig, 2 tab, 9

Descriptors: *Algorithms, *Tile drains, *Model studies, *Mathematical studies, *Soil water, Design criteria, Design standards, Hydrology, Hydraulic conductivity, Permeability coefficient, Drainage,

An algorithm is presented for calculating tile drain spacing for layered soils. The algorithm also works for homogeneous soils, as a special case of layered soils. The algorithm applies to potential flow theory developed for steady-state conditions in horizontal soils. A small programmable desk-top computer suffices for necessary computations. The algorithm can provide results to four or more significant figures for a wide range of design parameters. An example table of spacing values is given for hydraulic conductivity ratios of the upper to the lower soil layer of 50, 10, 5, 2, 1, 1/2, 1/5, 1/10, and 1/50. The results agree with earlier nomograph results but are more precise. The earli-1/3, 1/10, and 1/30. The results agree with earlier nomograph results but are more precise. The earlier nomographs can provide starting values for the algorithm, but such starting values are not neces-sary. (Author's abstract) W88-07987

MOVEMENT OF AMMONIUM NITRATE INTO UNSATURATED SOIL DURING UNSTEADY ABSORPTION,

Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant

Physiology. B. E. Clothier, T. J. Sauer, and S. R. Green. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 340-345, March-April 1988. 3 fig, 13 ref.

Descriptors: *Ammonium compounds, *Ammonium, *Nitrates, *Unsaturated soils, *Absorption, *Adsorption, *Solute transport, *Path of pollutants, *Model studies, *Soil water, Mathematical studies, Prediction, Hydrology, Ions, Wetting, Soil types, Loam, Sand, Bromides.

An approximate theory for multi-dimensiona transport of inert tracer and reactive chemical during transient wetting of soil is presented. One-dimensional, unsteady absorption experiments with a free-water solution of potassium bromide and a free-water solution of potassium bromide and ammonium nitrate were carried out in two contrasting soils. The sill loam had an ammonium solution-sorbed distribution coefficient of 5 L/kg, while the fine sand had a distribution coefficient of 2.6 L/kg. These adsorption data were derived from steady-state, miscible displacement experiments. The dispersion profiles of bromide, nitrate, and ammonium were reasonably described by the theory in its one-dimensional form. Time-dependency observed in ammonium adsorption, yet ignored by the theory, is considered to have led to an underprediction of dispersion. (See also W88-07989) (Author's abstract)

NITROGEN TRANSPORT DURING DRIP FER-TIGATION WITH UREA, Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant

Physiology. B. E. Clothier, and T. J. Sauer.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 345-349, March-April 1988. 6 fig, 1 tab, 9

Descriptors: *Nitrogen, *Urea, *Irrigation water, *Path of pollutants, *Drip irrigation, *Fertilization, *Solute transport, *Model studies, *Soil water, Hydrology, Mathematical studies, Prediction, Hydrogen ion concentration, Nitrates, Ammonium, Nitrogen compounds, Loam.

Urea added to drip irrigation water will be rapidly hydrolyzed in the soil to ammonium and then oxidized to nitrate. An approximate theory is presented for the unsteady, three-dimensional transport of water and N through unsaturated soil around a dripper discharging a urea solution. The results were compared with measurements from laboratory experiments with repacked silt loam.

Water and solute movement in the course of the irrigation cycle and during the subsequent redistribution are considered. The theory successfully located the penetration of both the inert nitrate and reactive ammonium derived from the applied urea. It was possible to predict the direction, and approximate the magnitude of pH changes proximate to the emitter. (See also W88-07988) (Author's abstract) W88-07989

NONCONTACT LASER SYSTEM FOR MEAS-URING SOIL SURFACE TOPOGRAPHY, National Soil Erosion Lab., West Lafayette, IN. For primary bibliographic entry see Field 7B.

SEEPAGE IN A SATURATED-STRATIFIED AQUIPER WITH RECHARGE.

Agricultural Research Service, Riverside, CA. Saty Lab. For primary bibliographic entry see Field 2F.

SPATIAL AND TEMPORAL DISTRIBUTION OF SOIL WATER IN THE TILLED LAYER UNDER A CORN CROP,

Guelph Univ. (Ontario). Dept. of Land Resource

I. J. van Wesenbeeck, and R. G. Kachanoski. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 363-368, March-April 1988. 3 fig, 5 tab, 19

Descriptors: *Cultivated lands, *Topsoil, *Soil water, Plant growth, Crop yield, Spatial distribution, Temporal distribution, Hydrology, Recharge, Rainfall, Corn, Clay loam, Ontario, Canada, Density, Drying, Interception.

Measurements of the spatial distribution of the surface layer (0-0.2 m) soil-water content under a corn crop, (Zea mays L.) throughout the growing season were obtained on a Typic Hapludalf (London sitty clay loam) soil near Guelph, Ontario, Canada. One hundred surface soil water content measurements were taken nondestructively every 1 to 2 d in a 20-m long transect using permanently placed time domain reflectometry (TDR) transmis-sion line probes. The sampling interval was set so ston me protect. The samping meet val was set so that between every two rows of corn in the tran-sect, a TDR probe was situated in each row, directly between the rows (interrow) and halfway between each row and interrow position. Systematic spatial differences in surface soil water content were observed throughout the growing season with the interrow position almost always greater than the row position. Significantly lower bulk than the row compared to the interrow ac-counted for differences early in the growing season. Significantly higher drying rates in the row caused greater differences at later crop growth stages. Soil water recharge from rainfall was also greater in the row compared to interrow, which stages. Soil water recharge from rainfall was also greater in the row compared to interrow, which was attributed to interception and subsequent stemfow. The preferential drying and recharge in the row area caused the spatial variability to be time-dependent and the temporal variability to be space dependent. (Author's abstract)

EFFECT OF LOW ELECTROLYTE CONCENTRATION ON HYDRAULIC CONDUCTIVITY OF SODIUM/CALCIUM-MONTMORILLON-

Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.

R. Keren, and M. J. Singer.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 368-373, March-April 1988. 8 fig. 11 ref.

Descriptors: *Sodium, *Calcium, *Montmorillon-ite, *Sand, *Electrolytes, *Percolation, *Hydraulic conductivity, *Soil water, *Soil mechanics, Hy-drology, Soil properties, Clay, Performance eval-uation, Adsorption, Flocculation.

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The effect of electrolyte concentration in the per-colating solution on hydraulic conductivity (HC) of Na/Ca-montmorillonite-sand mixtures at ex-changeable sodium percentage (ESP) 5, 10, and 20 was studied. The HC was decreased following a decrease in electrolyte concentration. The HC of was studied. The HC was decreased following a decrease in electrolyte concentration. The HC of the system at sodium adsorption ratio 10 dropped to a very low value and no clay was observed in the leachate, when the 10 mol/cu m solution was replaced with solution of lower concentration prior to introducing distilled water. On the contrary, when the 10 mol/cu m solution was replaced by distilled water the HC dropped sharply followed by a sharp increase and clay leaving the column. The time it took to obtain the constant HC depends upon ESP. The higher the ESP the longer the time. The degree of swelling of clay before replacing the solution with electrolyte concentration below the flocculation value (FV) determines whether clay will leave the system. A subsequent introduction of a solution with electrolyte concentration below FV, causes a further decrease in pore radii and part of the dispersed tactoids at sodium adsorption ration (SAR) 10 and 20 are trapped in the narrow pores. Thus, because of the sieving effect, the HC further decreased but no clay appeared in the leachate. At SAR 5, an increase in HC was obtained when 1 mol/cu m solution was replaced with distilled water. This increase was due to clay dispersion and movement out of the system because swelling is limited at increase was due to clay dispersion and movement out of the system because swelling is limited at SAR 5. (Author's abstract)

EFFECTS OF SOIL AND NITROGEN ON WATER USE EFFICIENCY OF TALL FESCUE AND SWITCHGRASS UNDER HUMID CONDI-

TIONS,
Agricultural Research Service, University Park,
PA. Regional Pasture Research Lab.
For primary bibliographic entry see Field 2I.
W88-07995

CHARACTERIZING MACROPORES THAT AFFECT INFILTRATION INTO NONTILLED

AFFECT INTELLIBRATION OF A STATE OF A STATE

Redmond. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 483-487, March-April 1988. 4 fig, 4 tab, 19

Descriptors: "Macropores, "Infiltration, "Infiltra-tion rate, "Watersheds, "Soil mechanics, "Soil water, Hydrology, Spatial distribution, Rainfall, Runoff, Porosity, Ohio, Corn, Loam, Cultivation.

A 0.5-ha watershed of Rayne silt loam on 9% slope at Coshocton, Ohio was farmed for 20 yr in contin-uous no-till corn (Zea mays L.). With average rainfall > 1 m/yr, runoff from this mulch-covered surface averaged < 2 mm/yr. Previous dye studies show that even at low rainfall rates, water moves rapidly through vertically continuous macropores (mainly earthworm burrows) in this field that hasn't been tilled since 1960. To characterize the distribution of these pores, we photographed cleaned, horizontal 30.5- by 30.5-sq cm surfaces at depths of 2.5, 7.5, 15, and 30 cm. The images were depths of 2.5, 7.5, 15, and 30 cm. The images were scanned with an image analyzer to count and determine the size of open pores. With eight replications at each depth, total number of pores > 0.4 mm in diameter per sq m of surface area ranged from 3369 to 21,151 in the 2.5-cm depth and from 5673 to 28,966 at the 30-cm depth. The overall average was 14,576 pores per sq m, 160 of which were > 5 mm in diameter. Mean pore diameter ranged from 1 to 2 mm at all depths and the number of pores was inversely proportional to number of pores was inversely proportional to pore diameter. There were more pores at the lower depth than near the surface. Pores > 0.4 mm in diameter accounted for approximately 1.4% of the total area. (Author's abstract)

ROOT GROWTH IN A CLAYPAN WITH A PE-RENNIAL-ANNUAL ROTATION, Kansas Agricultural Experiment Station, Manhat-

tan. Evapotranspiration Lab. For primary bibliographic entry see Field 21. W88-07997

OPTIMAL DESIGN OF FIELD EXPERIMENTS FOR DETERMINATION OF PRODUCTION FUNCTIONS,

Stichting voor Bodemkartering, Wageningen (Netherlands). Dept. of Soil Physics and Hydrolo-For primary bibliographic entry see Field 3F.

RELATIONS AMONG SULFATE, ALUMINUM, IRON, DISSOLVED ORGANIC CARBON, AND PH IN UPLAND FOREST SOILS OF NORTH-WESTERN MASSACHUSETTS, Williams Coll., Williamstown, MA. Center for Environmental Studies.

For primary bibliographic entry see Field 5B. W88-07999

ORGANIC MATTER SOLUBILITY AND SOIL REACTION IN AN AMMONIUM AND PHOSPHOROUS APPLICATION ZONE, as State Univ., Manhattan. Dept. of Agrono-

my. R. G. Myers, and S. J. Thien. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 516-522, March-April 1988. 3 fig, 5 tab, 15

Descriptors: *Organic matter, *Solubility, *Soil reaction, *Fertilizers, *Soil water, *Water chemistry, Soil columns, Hydrology, Ammonium, Phosphorus, Hydrogen ion concentration, Loam, Leaching.

We studied the effect of N and P fertilizers on soil we studied the effect of N and P tertilizers on soil organic-matter solubility and pH in a Kennebec silt loam. Soil columns, 7 cm in diameter, were treated with 20 combinations of ammonium hydroxides nitrogen (NH4OH-N) and either monoammonium phosphate (MAP) or triammonium pyrophosphate (TPP), then incubated from 0.5 to 16 d. As NH46H-N rates increased from 0 to 600 to 1200 to 2400 mg/kg, dissolved organic matter (DOM) in leachate from the application zone (2.5 cm above and below the application point) increased from 62 to 199 to 389 to 564 mg/kg, respectively, averaged over all incubation periods and P treatments. As MAP rates increased from 0 to 300 to 600 mg P/kg, DOM in leachate increased from 167 to 308 to 344 mg/kg, respectively, averaged over all periods and N treatments. Corresponding rates of TPP resulted in 167, 289, and 410 mg/kg of DOM. When NH40H-N and either P source were applied in combination, interactions between the feptiled in combination, interactions between the fermion of the property of the source of the sour NH4OH-N rates increased from 0 to 600 to 1200 to When NH4OH-N and either P source were applied in combination, interactions between the fertilizers usually synergistically increased organic-matter solubility, often by a factor of 1.5 to 2.0. Leachates were colored shades of amber, brown, or black depending upon the amount and nature of the DOM. As NH4OH-N rates increased from 0 to 600 to 1200 to 2400 mg/kg, pH of leachate from the application zone increased from 6.2 to 8.1 to 9.0 to 9.4, respectively, when averaged over all incubation periods and P treatments. Both P sources decreased pH. Increased in DOM were highly correlated to increases in pH. The R2 values for the regression of DOM on pH ranged from 0.83 to 0.99. (Author's abstract)

SOIL MODULUS OF RUPTURE AS AFFECTED BY WETTING UNDER VACUUM. Agriculture and Wat Centre, Baghdad (Irag). Water Resources Research For primary bibliographic entry see Field 8D. W88-08001

VARIABILITY OF SOIL WATER PROPERTIES AND CROP YIELD IN A SLOPED WATER-SHED,

SHED, Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab. J. W. Naney, R. D. Williams, and L. R. Ahuja. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 281-288, April 1988. 3 fig, 5 tab, 17 ref.

Descriptors: *Crop yield, *Slopes, *Watersheds, *Soil-water-plant relationships, *Soil water, Soil mechanics, Hydraulic conductivity, Spatial distribution, Watersheds, Hydrology, Prediction, Model studies, Climate, Rainfall, Soil texture, Soil moisture retention, Regression analysis, Soil erosion, Soil properties, Available water, Water yield, Silt, Infiltration capacity.

Spatial distribution of soil and water properti the correlations between them and crop yield were determined for a natural rainfall environment. Hydetermined for a natural rainfall environment. Hydraulic conductivity, soil texture, water retention, and soil-water flux were variables used to investigate their relationship to crop yield using multiple regression techniques. Variations in crop yields on a watershed with a 3 to 4 percent slope and moderately erosive soils were related to soil-water characteristics and soil properties along slope and with depth. Climate conditions to sustain crop growth and yield ranged from inadequate soil water in 1983 to adequate soil water in 1983 to adequate soil water in 1983 to adequate soil water polydwas predicted with models using both available and measured soil-water content. Available water content provided a better model for the prediction of water yield and does not require field measurements of actual soil-water content. Soil water holding capacity was more significant for predicting crop yield in soils with moderate to high silt content than infiltrability of water into the soil. (Author's abstract) W88-08034

INFILTRATION AND WATER QUALITY ON RANGE SITES AT FORT STANTON, NEW MEXICO,

New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences.

For primary bibliographic entry see Field 4C.

W88-08038

TWO-STAGE WEIR CONTROL OF SUBSUR-FACE DRAINAGE FOR WATER TABLE MAN-

Agricultural Research Service, Baton Rouge, LA. Soil and Water Pollution Research Unit. For primary bibliographic entry see Field 3F. W88-08064

DISTRIBUTION COEFFICIENTS OF CD, CO, NI, AND ZN IN SOILS, Technical Univ. of Denmark, Lyngby. Dept. of

Sanitary Engineering.
For primary bibliographic entry see Field 5B.
W88-08134

ESTIMATING THE HYDRAULIC PROPERTIES OF SOIL: PART 3. PARAMETERS OF THE PHILIP INFILTRATION EQUATION, Butler Univ., Indianapolis, IN. Holcomb Res

A.I. El-Kadi.

Advances in Water Resources AWREDI, Vol. 9, No. 1, p 16-23, March 1986. 8 fig, 5 tab, 22 ref.

Descriptors: *Soil water, *Sorption, *Free water, *Infiltration, *Permeability coefficient, *Moisture, *Mathematical equations, Philip infiltration equa-

Using a large number of experimental data, the parameters of the Philip infiltration equation were estimated. The values of these parameters are obtained using the Philip approach, which employs the hydraulic properties of soil. In the absence of extensive measurements, the tabulated results can be used in modeling infiltration. The paper introduces approximate sorptivity expressions that use a limited number of parameters. Sorptivity may be estimated reasonably well from a knowledge of moisture deficit, a representative capillary pressure, and saturated hydraulic conductivity. The accuracy of prediction is highest for coarser materials. For coarse materials (sands), second-power sorptivity can be approximated as a linear function of initial effective saturation. The proposed expresof initial effective saturation. The proposed expressions for sorptivity can be used as a substitute for the lengthy Philip procedure. (Author's abstract)

W88-08175

KINEMATIC WAVE APPROXIMATION TO THE INITIATION OF SUBSURFACE STORM LOW IN A SLOPING FOREST SOIL, irginia Univ., Charlottesville. Dept. of Environ-FLOW IN A SLOPING FOREST SOIL, Virginia Univ., Charlottesville. Dept. of Environ-mental Sciences. P.F. Germann, R.S. Pierce, and K. Beven. Advances in Water Resources AWREDI, Vol. 9, No. 2, p 70-76, June 1986. 3 fig, 3 tab, 16 ref.

Descriptors: *Storm seepage, *Groundwater movement, *Infiltration, *Mathematical models, *Hydrologic models, *Forest soils, *Flow chara-teristics, *Subsurface drainage, *Kinematic wave

Subsurface storm flow can be explained by quick response of groundwater flow to infiltration. The corresponding fast infiltration from the soil surface to the saturated soil layer was approached by macropore flow concepts that are based on kinematic flow theory. The distribution of the flow parameters (i.e., macropore conductance, b, and sorbance, r), that are used to represent the macropore flow processes within a given soil, were derived upon the separation of drainage hydrographs. The approach is valid over time intervals lasting about twice the duration of water input to the surface. The drainage hydrographs were obtained by sprinkling on an undisturbed block of forest soil. The block was underlain by impermeable glacial till. The macropore flow distribution function model creditably reproduced the hydrograph time to peak for a number of experiments. graph time to peak for a number of experiments. The importance of saturated layers on the generation of subsurface storm flow is demonstrated. (Author's abstract)

DERIVATION OF BASIC EQUATIONS OF MASS TRANSPORT IN POROUS MEDIA: PART I. MACROSCOPIC BALANCE LAWS, Rijksinstitut voor de Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands). For primary bibliographic entry see Field 5B. W88-08188

DERIVATION OF BASIC EQUATIONS OF MASS TRANSPORT IN POROUS MEDIA: PART 2. GENERALIZED DARCY'S AND FICK'S LAWS,

Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Leidschendam (Netherlands). For primary bibliographic entry see Field 5B. W88-08189

HYDROLOGICAL ANALYSIS OF BASIN BE-HAVIOR FROM SOIL MOISTURE DATA. Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society. L. Anderson

Nordic Hydrology NOHYBB, Vol. 19, No. 1, p 1-18, 1988. 13 fig, 1 tab, 18 ref, 2 append.

Descriptors: *Hydrology, *Soil Water, *Water-sheds, Basins, Moisture content, Moisture deficien-cy, Interception, Spatial variation, Percolation, Evapotranspiration, Forest, Grassland, Root distri-bution, Rain runoff, Seasonal variation, Model studies, Mathematical model, Sweden.

Soil moisture dynamics in the Velen drainage basin (Sweden) were analyzed in order to assess the degree of and the reasons for spatial variation in basin behavior. The main tool was a modified version of the soil moisture accounting routine in the conceptual runoff model HBV, optimized against neutron probe field data. Simulated soil moisture dynamics, interception and percolation rates agreed with measurements and other calculations. Integration of simulated evapotranspiration from sites with different characteristics agreed well with water balance computations for the area. It was shown that unsaturated flow through macropores probably occurred after heavy rainstorms. During spring, evapotranspiration was limited to values below the potential (Penmans equation) even at times when no soil moisture deficit existed. oisture dynamics in the Velen drainage ba

Soil moisture differences between forest and grass-land (including a deforested site) were, during summer, mainly attributed to differences in the root distribution with depth. The effect of interroot distribution with depth. The effect of inter-ception on the total evapotranspiration rates was only significant during periods when transpiration demands were low. Soil moisture differences be-tween forest sites were mainly attributed to topog-raphy but variations in soil characteristics and root distribution had to be considered, especially during dry periods. (Author's abstract) W88-08291

EXPLICIT INFILTRATION EQUATIONS BASED ON THE GREEN-AMPT MODEL, Saskatchewan Univ., Saskatcon. Dept. of Agricultural Engineering.

K. P. Thooyamani, and D. I. Norum.
Canadia: Current of Civil Engineering CICERS **EQUATIONS**

Canadian Journal of Civil Engineering CJCEB8, Vol. 14, No. 5, p 710-713, October 1987. 2 fig, 1 tab, 8 ref.

Descriptors: *Hydrology, *Irrigation *Model studies, *Soil mechanics, *Infiltration, *Green-Ampt equations, *Hydrologic models, Soil properties, Soil texture.

The Green-Ampt infiltration equations are based on physical parameters of the soil that can be either measured or calculated reasonably easily. However, neither the infiltration rate equation nor the cumulative depth of infiltration equation is in a form that can be used easily in hydrologic modeling, as both equations are in an implicit form when time is the independent variable. Therefore iterative procedures must be used to find either the infiltration rate or cumulative depth at a specific time. Explicit infiltration equations have been developed, based on the Green-Ampt infiltration rate and the cumulative depth of infiltration with a maximum deviation from the Green-Ampt equations of 2.5% for any time. The derived equations have been put in dimensionless form by choosing appropriate length and time scales. Approximate values for the length and time scales for 11 differents oil textures, ranging from sand to clay, are given. (Author's abstract)

TRANSIENT SEEPAGE MODEL FOR SATURATED-UNSATURATED SOIL SYSTEMS: A GEOTECHNICAL ENGINEERING AP-Saskatchewan Univ., Saskatoon. Dept. of Civil En-

gineering.
For primary bibliographic entry see Field 2F.
W88-08307

VADOSE ZONE CHARACTERIZATION OF LOW-PERMEABILITY SEDIMENTS USING FIELD PERMEAMETERS, New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience. For primary bibliographic entry see Field 2F. W88-08310

MEASUREMENT OF CARBON DIOXIDE IN SOIL GASES FOR INDICATION OF SUBSURFACE HYDROCARBON CONTAMINATION, Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV. Advanced Monitoring Systems Dept.

H. B. Kerfoot, C. L. Mayer, P. B. Durgin, and J. J.

D'Lugosz. Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 67-71, Spring 1988. 1 fig, 2 tab, 23

Descriptors: *Groundwater pollution, *Soil contamination, *Carbon dioxide, *Organic matter, *Hydrocarbons, *Path of pollutants, Chemical properties, Soil gases, Correlation analysis.

A preliminary field evaluation of a new application of soil-gas measurement for delineation of subsur-face organic contamination is described. The method measures carbon dioxide concentrations in soil gases and is based on the hypothesis that

carbon dioxide concentrations from subsurface oxidation of organic compounds will be proportional to the extent of organic contamination. A correlation coefficient (r) of 0.81 (n=6) was observed between ground water dissolved organic carbon ground water concentrations and carbon dioxide concentrations in the overlying soil gases at one site. Soil-gas carbon dioxide concentrations meas-ured ranged from 0.09% to 0.45%. (Author's abstract) W88-08311

REPRESENTATIVENESS OF PORE WATER SAMPLES COLLECTED FROM THE UNSATU-RATED ZONE USING PRESSURE-VACUUM LYSIMETERS. Geological Survey, Denver, CO. Water Resources

For primary bibliographic entry see Field 7B. W88-08314

THREE-DIMENSIONAL ANALYTICAL MODEL TO AID IN SELECTING MONITOR-ING LOCATIONS IN THE VADOSE ZONE, IRS, IN LOCATION LOCATION LOCATIONS IN THE VADOSE ZONE, INS, INC. THREE-DIMENSIONAL In-Situ, Inc., Laramie, WY.
For primary bibliographic entry see Field 7A.
W88-08317

SOLUTE TRANSPORT SIMULATION OF AQ-UIFER RESTORATION AFTER IN SITU URA-NIUM MINING,

Idaho Univ., Moscow. Coll. of Mines and Earth Resources.

For primary bibliographic entry see Field 4B. W88-08318

APPLICATION OF A SIMPLE SOIL-WATER HYSTERESIS MODEL.

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies. W. L. Hogarth, J. Hopmans, J. Y. Parlange, and R.

Haverkamp.

Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 21-29, March 15 1988. 5 fig, 8 ref.

Descriptors: *Soil water, *Model studies, *Hysteresis, Mathematical models, Scanning curves.

A simple hysteresis model was reformulated on the basis of the Brooks and Corey equation for the relationship between soil-water content and matric potential. In principle, the method requires the knowledge of a drying curve (boundary or primary) to predict the wetting boundary and all scanning curves. Experimental observations used recently to assess a variety of soil-water hysteresis models show that the hysteresis model is simple, accurate and general. (Author's abstract)

W88-08325

INTERRELATION OF HYDRAULIC AND ELECTRICAL CONDUCTIVITIES, STREAMING POTENTIAL, AND SALT FILTRATION DURING THE FLOW OF CHLORIDE BRINES THROUGH A SMECTITE LAVER AT ELEVATED PRESSURES,

Illinois Univ., Urbana. Dept. of Geology. For primary bibliographic entry see Field 5B. W88-08326

TRANSPORT OF WATER IN FROZEN SOIL:

VI. EFFECTS OF TEMPERATURE,
Cold Regions Research and Engineering Lab.,
Hanover, NH. Y. Nakano, and A. R. Tice.

Advances in Water Resources AWREDI, Vol. 10, No. 1, p 44-50, March 1987. 7 fig. 1 tab, 9 ref, append.

Descriptors: *Soil water, *Water transport, *Frozen ground, Diffusivity, Soil temperature, Mathematical analysis, Temperature effects.

Effects of temperature on the transport of water in frozen soil were studied under isothermal conditions. The diffusivity of water was determined as a

Group 2G-Water In Soils

function of the total water content at several differrunction of the total water content at several differ-ent negative temperatures under the assumption that the flux of water is proportional to the gradi-ent of total water content. A common feature found was that the diffusivity function has two peaks. One of them is near a point where total water content is 1.0% and another is near a point where total water content is equal to the equilibri-um unfrozen water content. The validity of the assumption on the flux of water was examined and assumption on the ritus of water was examined and the method of analysis used to determine the diffu-sivity was discussed with particular emphasis on the appearance of a discontinuity in experimental profiles of total water content. (Author's abstract) W88-08339

STEADY TWO- AND THREE-DIMENSIONAL FLOW FROM SATURATED TO UNSATURAT-ED SOII Arizona Univ., Tucson. Dept. of Soil and Water

Science.

A. W. Warrick, and R. Zhang.

Advances in Water Resources AWREDI, Vol. 10,

No. 2, p 64-68, June 1987. 8 fig, 2 tab, 16 ref,

Descriptors: *Groundwater movement, *Soil saturation, *Soil water, *Flow, *Hydraulic conductivity, Mathematical analysis, Pits, Trenches, Irriga-

Geometries are relevant with respect to pits, trenches and irrigation furrows. Simplified analytical approximations are made by matching solutions for lines, cylinders, points and spheres in saturated soils to solutions for buried lines and points in unsaturated soils. The two-dimensional case corresponds to flow resulting from a positive hydraulic pressure beneath a trench or canal. Such a solution is relevant, for example, for testing suitability of septic tanks involving flow from trenches or for furrow irrigation. (Author's abstract) W88-08341

MISCIBLE FLOW THROUGH POROUS MEDIA WITH DISPERSION AND ADSORP-TION.

Universidad Nacional de La Plata (Argentina For primary bibliographic entry see Field 2F. W88-08348

ORTHOGONAL COLLOCATION AND ALTERNATING-DIRECTION PROCEDURES FOR UNSATURATED FLOW PROBLEMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering. M. A. Celia, L. R. Ahuja, and G. F. Pinder. Advances in Water Resources AWREDI, Vol. 10, No. 4, p 178-187, December 1987. 11 fig. 35 ref. National Science Foundation Grant CEE-8111240A02, Department of Energy Grant DE-ACO2-83ER60-170 MODA002, and MIT Sloan Basic Research Grant 26950.

Descriptors: *Soil water, *Unsaturated flow, *Porous media, *Soil water, Mathematical analysis, Algorithm, Simulation analysis.

sus, Algorithm, Simulation analysis.

The alternating-direction collocation method has recently been developed for general parabolic equations. In order to test the applicability of the procedure to highly nonlinear problems, an alternating-direction collocation algorithm is developed to simulate two-dimensional flow in unsaturated porous media. The algorithm employs an alternating-direction solution procedure within the framework of a modified Picard iteration scheme. Numerical behavior of he new procedure is compared to the behavior of a standard two-dimensional collocation formulation. The new method is also tested on several infiltration problems of practical interest, including a layered and sloping soil. Results demonstrate the method to be accurate and highly mass conservative. The algorithm also produces significant savings in both execution time and storage. (Author's abstract)

FACTORS INFLUENCING ENTRY OF PESTI-CIDES INTO SOIL WATER,

Rothamsted Experimental Station, Harpenden For primary bibliographic entry see Field 5B. W88-08374

MYCORRHIZAE, SOIL AMENDMENTS, WATER RELATIONS AND GROWTH OF ROSA MULTIFLORA UNDER REDUCED IRRIGATION REGIMES, Texas A and M Unit,, College Station. Dept. of Hostigaltynal Sciences.

Horticultural Sciences

F. T. Davies, Y. Castro-Jimenez, and S. A. Duray. Scientia Horticulturae SHRTAH, Vol. 33, No. 3/ 4, p 261-267, November 1987. 4 tab, 18 ref. Center for Energy and Mineral Resources Grant No.

Descriptors: *Plant physiology, *Plant growth, *Fungi, *Soil amendments, *Irrigation, *Soil-water-plant relationships, *Plant water potential, *Mycorrhizae, Roses, Hydrogel, Polyethylene oxide, Mulches, Water stress, Transpiration.

To determine the role of endomycorrhizae and selected soil amendment treatments on water rela-tions and growth of Rosa multiflora, rooted cuttions and growth of Rosa mutinfora, rooted cut-tings were planted in a medium with either incor-porated hydrogel (polyethylene oxide) or a syn-thetic mulch surface covering (wax-impregnated cardboard) and either inoculated with vesicular-arbuscular mycorrhizal fungi (VAM) (Gloma mosseae and G. fasciculatum) or left as non-inoculated controls. Plants were initially irrigated daily, but then irrigation was reduced to three times weekly before water-stress cycles were initiated. Shoot and root dry weight and root; shoot ratio were higher when hydrogel was incorporated in the medium, regardless of VAM colonization treatthe meanum, regardless of vAM Colonization treat-ments. Xylem water potential in shoots of roses with hydrogel-incorporated medium was lowest (more negative) and had the greatest changes re-gardless of mycorrhizal treatment. In general, my-corrhizal plants had lower transpiration rates and a higher diffusive resistance, either with or without hydrogel incorporation in medium. (Author's ab-stract) stract) W88-08376

STRAW BURNING REDUCES INFILTRATION IN WINTER WHEAT, Kansas State Univ., Manhattan. Dept. of Agricul-

tural Engineering.
For primary bibliographic entry see Field 3F.
W88-08383

DETECTION OF SOIL DRAINAGE IN 'PAYS DE HERVE' - BELGIUM - ON LANDSAT MSS

IMAGERY, Ghent Rijksuniversiteit (Belgium). Lab. voor Regionale Geographie en Landschapskunde. For primary bibliographic entry see Field 7C. W88-08474

LASER FLASH PHOTOLYTIC STUDIES OF A WELL-CHARACTERIZED SOIL HUMIC SUB-

Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Chemistry. For primary bibliographic entry see Field 5B. W88-08533

WORMS AND WATER, Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. W. D. Kemper, T. J. Trout, A. Segeren, and M.

Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 6, p 401-404, November-December 1987. 10 ref.

Descriptors: *Agriculture, *Worms, *Soil water, *Rainfall-runoff relationships, *Infiltration rate, *Soil porosity, Root zone, Irrigation, Rainfall.

A raindrop's value to a farmer depends upon whether that raindrop is available or not available to the farmer's crop. Rates at which cloud bursts deliver water often exceed the rates at which

water can move into the root zones of crops water can move into the root zones of crops through the tiny pores between soil particles. Small puddles of water then develop on the surface. These puddles may grow until water flows over the lowest banks, joining overflow from millions of other puddles to flood nearby creeks. Meanwhile, much of the crop root zone remains dry. Farmers can't do much about the amount of rain they will get, but findings indicate that farmers can work with worms to capture precipitation in the root zones of their crops. Real potential exists for managing worms to improve water managefor managing worms to improve water manage-ment. More must be learned about the burrowing ment. More must be learned about the burrowing pressures that different species can exert, how fast populations can regenerate under different climatic and plant residue conditions, what chemicals reduce worm populations, and so forth. Only now are researchers beginning to understand how badly worms have been treated and how much they can do for farmers and conservationists if treated right. (Alexander-PTT) (Alexander-PTT) W88-08620

SOIL WATER REGIMES OF LOAMY SANDS AND SANDY LOAMS ON ARID RANGE-LANDS IN SOUTHERN NEW MEXICO,

New Mexico Agricultural Experiment Station, Las

C. H. Herbel, and R. P. Gibbens. C. H. Herbel, and R. P. Globens.

Journal of Soil and Water Conservation JSWCA3,

Vol. 42, No. 6, p 442-446, November-December

1987. 2 fig, 4 tab, 17 ref.

Descriptors: *Soil types, *Loam, *Sand, *Arid lands, *Rainfall, *Matric potential, *New Mexico, *Soil water, *Soil properties, *Permeability coefficient, *Hydraulic conductivity, Seasonal variation, Model studies, Mathematical studies, Topography.

The matric potential of soil water is presented for five loamy sand and six sandy loam sites on arid rangelands. Gypsum-impregnated resistance blocks were placed at five soil depths to 91 cm. If caliche was encountered before the 91-cm depth, blocks were placed to that level. The average sinual precipitation during the approximate 20-year study period was 237 mm, slightly above the long-term mean. At the 10-cm depth, the probability of soil matric potential > or = -1.5 MPa during December-April was 60% at the 11 sites; 83% of the probability was > or = -0.1 MPa. (O MPa is the equivalent of 10 bars.) During July-September, the probability of soil matric potential at the 10-cm depth was 53%; 73% was > or = -0.1 MPa. Factors affecting soil matric potential were precipitation amount, surface soil characteristics, to-pography, subsurface conditions, and season of the The matric potential of soil water is presented for pography, subsurface conditions, and season of the year. (Author's abstract) W88-08624

INFILTRATION INTO A SEASONALLY FROZEN AGRICULTURAL SOIL,

Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center. J. F. Zuzel, and J. L. Pikul.

Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 6, p 447-449, November-December 1987. 5 fig, 3 tab, 16 ref.

Descriptors: *Soil water, *Tillage effects, *Frozen ground, *Infiltration, *Simulated rainfall, Soil me-chanics, Seasonal variation, Soil properties, Frost, Cultivated lands, Runoff, Erosion, Infiltration rate,

Low infiltration rates in frozen soil are a major Contributor to water runoff, soil erosion, and sedimentation in the Pacific Northwest region of the United States. A rainfall simulator used as a sprinkler infiltrometer was employed to determine the infiltration characteristics for three tillage treatments: standing stubble, chiseled stubble, and newly seeded winter wheat after summer fallow. Infiltration measurements were conducted in the fall of 1984 directly after tillage, in the winter when the soil was frozen, and in the spring when the soil thawed. Infiltration in frozen soil was determined after frost had penetrated to a prede-termined depth in each treatment. Final infiltration rates in unfrozen soil were greatest for the chiseled

Lakes-Group 2H

stubble and least for the winter wheat treatments. stude and least for the winter wheat treatments. Frozen soil greatly reduced infiltration for the chiseled- and standing-stubble treatments when compared to the rates measured in the fall and spring. No infiltration was observed on winter wheat while the soil was frozen. (Author's ab-W88-08625

REVIEW OF SOIL SOLUTION SAMPLERS, Colorado Univ., Boulder. Inst. of Arctic and Alpine Research. For primary bibliographic entry see Field 7B. W88-08666

DEVELOTING JOINT PROBABILITY DISTRI-BUTIONS OF SOIL WATER RETENTION CHARACTERISTICS, Environmental Research Lab., Athens, GA. R. F. Carsel, and R. S. Parrish. Water Resources Research WRERAO, Vol. 24, No. 5, p 755-769, May 1988. 12 fig, 8 tab, 23 ref.

Descriptors: *Mathematical models, *Probability distribution, *Soil water, *Soil absorption capacity, *Soil moisture retention, *Unsaturated flow, Moisture tension, Permeability coefficient, Solute transport, Regression analysis, Sand, Clays.

A method is presented for developing probability density functions for parameters of soil moisture relationships of capillary head h(theta) and hydraulic conductivity K(theta). These soil moisture parameters are required for the assessment of water flow and solute transport in unsaturated media. The method employs a statistical multiple regression equation previously proposed for estimating h(theta) or K(theta) relationships using the soil saturated water content and the percentages of sand and clav. In the absence of known statistical saturated water content and the percentages of sand and clay. In the absence of known statistical distributions for either h(theta) or K(theta) rela-tionships, the method facilitates modeling by pro-viding variability estimates that can be used to examine the uncertainty associated with water flow or solute transport in unsaturated media. (Author's abstract)

DEODMDDMBD OF MHSOSQOOY OF SISU-RATION IN A STRATIFIED SAND, New Mexico Inst. of Mining and Technology, Scoorro-Dept. of Geoscience. For primary bibliographic entry see Field 2F.

FOREST SOIL,
Technical Univ. of Denmark, Lyngby. Lab. of
Environmental Science and Ecology.
For primary bibliographic entry see Field 5B.
W88-08761

POROUS CUP SAMPLERS: CLEANING PROCEDURES AND POTENTIAL SAMPLE BIAS FROM TRACE ELEMENT CONTAMINATION, California Univ., Santa Cruz. Dept. of Earth Sci-

For primary bibliographic entry see Field 5A. W88-08911

CALCIUM SULFATE CRYSTALLIZATION ALONG CITRUS ROOT CHANNELS IN A FLORIDA SOIL EXHIBITING ACID SULFATE PROPERTIES.

Florida Univ., Gainesville. Dept. of Soil Science. S. K. Syslo, D. L. Myhre, and W. G. Harris. Soil Science SOSCAK, Vol. 145, No. 2, p 126-134, February 1988, 9 fig. 3 tab. 29 ref.

Descriptors: *Calcium Sulfate, *Gypsum, *Crystallization, *Soil water, *Solute transport, *Roots, *Root distribution, *Acidic soils, Root channels, X-ray diffraction, Florida, Infrared spectroscopy, Photomicrography. Conductivity, Sulfates, Ions, Scanning electron microscopy, Groundwater, Citrus bears.

The authors observed euhedral crystals in Manatee soil (coarse-loamy, siliceous, hyperthermic Typic Argiaquolls) in a citrus grove in St. Lucie County, Florida. The material was identified as gypsum (CaSO4-2H2O) using x-ray diffraction and infrared (CaSO4-2H2O) using x-ray diffraction and infrared spectra. Photomicrography and scanning electron microscopy revealed that gypsum accumulated both in old root channels and within citrus root tissue of the Btg horizon. The subsurface horizons had elevated sulfate levels, a low initial pH, a drop (0.5 unit) in pH upon air-drying. Electrical conductivity paralleled the concentration of water-soluble sulfate. High levels of calcium and sulfate occurred for horizons above the water table. This accumulation is attributed to groundwater bearing these into an aubsequently discharging them to the overlying soil. Dead citrus roots appear to act as wicks to aid water transfer from lower to higher horizons. aid water transfer from lower to higher horizons. and water transter from lower to higher horizons. The roots and their empty channels provide spaces in which gypsum can precipitate if the concentrations of calcium and sulfate in the evaporating groundwater exceed the solubility product of gypsum. (Author's abstract)

2H. Lakes

W88-08023

COMPONENTS OF THE SURFACE RADI-ATION BALANCE OF SUBARCTIC WETLAND TERRAIN UNITS DURING THE SNOW-FREE SEASON

McMaster Univ., Hamilton (Ontario). Dept. of Ge-For primary bibliographic entry see Field 2E.

HYDROLOGY OF ALASKAN WETLANDS,

U.S.A.: A REVIEW,
Cornell Univ., Ithaca, NY. Ecosystems Research

J. Ford, and B. L. Bedford. Arctic and Alpine Research ATLPAV, Vol. 19, No. 3, p 209-229, August 1987. 10 fig, 2 tab, 110 ref. U.S. Environmental Protection Agency Cooperative Agreement CR811060.

Descriptors: *Wetlands, *Hydrology, *Hydrologic cycle, *Alaska, *Flood peak, Permafrost, Glaciers, Stream ice, Hydrologic budget, Precipitation, Evapotranspiration, Ground ice, Snowmelt, Groundwater recharge, Literature review.

Alaska's wetland resources are vast and the literature dealing with any given aspect of Alaskan wetland hydrology is sparse. This review focuses on hydrological function and pays particular attention to (1) hydrologic inputs to and outputs from wetlands, and (2) the influence of wetlands on peak flow regulation. The influence of several characteristic high-latitude phenomena (permafrost, glaciers, and seasonal stream icings) on the overall water balance and the volume, areal distribution, rate, and timing of water release are discussed. Measured annual precipitation exceeds calculated annual evapotranspiration in most areas of the state, creating conditions suitable for the development of ombrotrophic wetlands. During snowmett, Alaska's wetland resources are vast and the literament of ombrotrophic wetlands. During snowmelt, which is the principal event in the annual hydrowhich is the principal event in the annual hydro-logic cycle in most areas of the state, wetland soils typically have high ice contents, and thus probably do not contribute significantly to either flood stor-age or groundwater recharge. The existence of permafrost is critical to the existence and function-ing of much of the areal extent of wetlands in the state. The implications of the state of our current understanding of Alaskan wetland hydrology for wetlands management are discussed. (Author's ab-stract) stract) W88-08025

PHYSICOCHEMICAL LIMNOLOGY OF MER-OMICTIC SALINE LAKE SOPHIA, CANADIAN ARCTIC ARCHIPELAGO,

Institut National de la Recherche Scientifique,

Sainte-Foy Quebec).
M. Ouellet, M. Bisson, P. Page, and M. Dickman.
Arctic and Alpine Research ATLPAV, Vol. 19,
No. 3, p 305-312, August 1987. 4 fig, 1 tab, 50 ref.

Descriptors: *Meromictic lakes, *Limnology, *Monimolimnion, *Arctic zone, Salinity, Water temperature, Permafrost, Meteoric water, Physicochemical properties, Salts, Mineralization, Lake Sophia, Canada.

The basic physicochemical characteristics of a Ca-The basic physicochemical characteristics of a Canadian High Arctic deep meromictic and mesothermic lake with an open drainage system are presented. The monimolimnetic salinity of Lake Sophia reaches 58 per thousand and its mid-water temperature is perenially at 12 C. This type lake is most commonly found in Antarctica, while so far only two have been reported from the Canadian Arctic. The salts of the monimolimnion seem to have originated during the postglacial marine submergence mainly from marine waters trapped within the ancient lake basin and beneath the surface of the area. It is most likely that the concentration of salts by freezing-out of ions from the face of the area. It is most likely that the concentration of salts by freezing-out of ions from the underground relict pore seawater was progressively brought about by the encroachment of permafrost on the newly uplifted lake surrounding. The water insulating layer could have caused the formation of a talik beneath the lake basin, which subsequently favored the displacement of the underground saline water toward the bottom of the lake. With time, some of the underground inflowing waters would have migrated to the mixolimon, there to be diluted with slightly mineralized meteoric waters before leaving the lake through the outflowing creek. (Author's abstract) W88-8026 W88-08026

DERIVING THE NONLINEAR RISK-BENEFIT ALGORITHM FOR RESERVOIRS,

Mahidol Univ., Bangkok (Thailand). Dept. of Environmental and Resource Studies. For primary bibliographic entry see Field 6A. W88-08031

WETLAND BOUNDARY DETERMINATION IN THE GREAT DISMAL SWAMP USING WEIGHTED AVERAGES,

Geological Survey, Reston, VA. V. Carter, M. K. Garrett, and P. T. Gammon. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 297-306, April 1988. 4 fig, 4 tab, 28 ref.

Descriptors: *Swamp, *Mapping, *Great Dismal Swamp, *Boundaries, *Wetlands, Statistical meth-ods, Model studies, Species composition, Vegeta-

A weighted average method was used to analyze transition zone vegetation in the Great Dismal Swamp to determine if a more uniform determina-tion of wetland boundaries can be made nationwide. The method was applied to vegetation data collected on four transects and three vertical layers across the wetland-to-upland transition zone of the swamp. Ecological index values based on water tolerance were either taken from the literature or derived from local species tolerances. Wetland index values were calculated for 25-m increments using species cover and rankings based on the ecological indices. Wetland index values were used to designate increments as either wetland, trans to designate increments as either wetland, transi-tional, or upland, and to examine the usefulness of a provisional wetland-upland break-point. Most in-crements were designated wetland or transitional when all species were used. Removal of three or five ubiquitous species either gave a wider range of wetland index values with a more variable designa-tion of increments or caused designation of increments to be similar for all layers. The use of locally-derived rankings showed the sensitivity of the weighted averages method to ecological indi-ces of species with large importance values. The weighted average method did not provide for an objective placement of an absolute wetland boundary, but did serve to focus attention of the transiand you are serve to tocus attention of the transi-tional boundary zone where supplementary infor-mation is necessary to select a wetland-upland break-point. (Author's abstract) W88-08036

TEMPERATURE AND THE PRODUCTIVITY-LIGHT RELATIONSHIP,

Group 2H-Lakes

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.

DESIGNATION OF WETLANDS BY WEIGHT-ED AVERAGES OF VEGETATION DATA: A PRELIMINARY EVALUATION, North Carolina State Univ. at Raleigh. Dept. of

T. R. Wentworth, G. P. Johnson, and R. L.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 389-396, April 1988. 1 fig. 3 tab, 23 ref.

Descriptors: *Weighted averages, *Wetlands, *Vegetation, Statistical methods, Model studies, Species composition, Regional analysis, Hydrolo-gy, Equations, Ecological distribution, Moisture gradient, Habitats, Soil types.

Weighted averages (WA) was investigated as a vegetation-based method for wetland designation, to be used in conjunction with the wetland indicator status of plants from Wetland Plants of the United States of America 1986. Ecological indices were assigned to indicator groups and were used to compute weighted averages for quantitative data obtained from four studies of wetland vegetation conducted in various regions of the United States. conducted in various regions of the United States. Weighted averages of vegetation data proved to be a useful tool for assessing wetland status of the vegetation types included in the study: (1) rankings of vegetation stands or types by WA correlated well with their positions on environmental moisture gradients; and (2) the results of WA could be used, together with a wetland/upland break-point, to designate vegetation types as wetland or upland in a way that agreed well, in three of the four studies, with an alternative classification of wet-land habitats. The variation of weighted averages land habitats. Ine variation of weighted averages among the sampling units representing a vegetation type was generally small relative to the range of ecological indices assigned. However, designations based on weighted average scores close to the break-point should be considered provisional and must be verified with supplementary data on soils and hydrology. (Author's abstract)

SIMPLE TECHNIQUE FOR ESTIMATING AB-SORPTION AND SCATTERING COEFFI-

Upstate Freshwater Inst., Inc., Syracuse, NY. For primary bibliographic entry see Field 7B. W88-08047

PALEOLIMNOLOGICAL EVIDENCE OF RECENT ACIDIFICATION IN TWO SUDBURY

(CANADA) LAKES,
Trent Univ., Peterborough (Ontario). Trent
Aquatic Research Centre.
For primary bibliographic entry see Field 5B.
W88-08068

LIMNOLOGICAL STUDIES ON THE NOZHA HYDRODROME, EGYPT, WITH SPECIAL REFERENCE TO THE PROBLEMS OF POL-

Alexandria Univ. (Egypt). Dept. of Oceanography. For primary bibliographic entry see Field 5B. W88-08070

QUANTITATIVE DIVING SURVEY OF BENTHIC VEGETATION AND FAUNA IN LAKE KARIBA, A TROPICAL MAN-MADE QUANTITATIVE LAKE.

we Univ., Harare, Lake Kariba Research Station.

Station.
C. Machena, and N. Kautsky.
Freshwater Biology FWBLAB, Vol. 19, No. 1, p
1-14, February 1988. 5 fig. 2 tab, 69 ref.

Descriptors: *Reservoirs, *Lake Kariba, *Benthic surveys, *Aquatic plants, *Benthic flora, *Benthic flauna, *Aquatic animals, Limnology, Optical prop-erties, Food chains, Aquatic habitats, Lakes, Predation, Biomass, Submerged plants, Surveys, Zam-

bazi River, Mussels, Snails, Insects, Larvae, Dams, merged plants, Surveys

The biomass distribution of submerged vascular vegetation and benthic fauna were investigated by diving in Lake Kariba. The vegetation was well correlated with transparency of the water. Maxicorrelated with transparency of the water. Maximum biomass and a depth penetration of 6 m were found in areas little influenced by river inflow, while these were only 110 g/sq m and 2 m, respectively, in the basin receiving water from the Zambezi river. The lake is mesotrophic-oligotrophic. The total biomass for the lake was 101,000 tons dry weight of rooted vegetation. Average plant biomass for the potentially colonizable depth zone of 0-12 m and for the total lake amounted to 79.9 g/sq. and 18.8 g/sq. m respectively. The distribution 0-12 m and for the total lake amounted to 79.9 g/sq m and 18.8 g/sq m, respectively. The distribution of the benthic fauna generally followed that of the vegetation. The total animal biomass of 118,840 tons dry weight, including shells, consisted of mussels, snails and insect larvae. Four species of mussels were found. Among the snails Melanoides tuberculata (Muller), Cleopatra spp. and Bellamya capillata (Frauenfeld) dominated. The average animal biomass was high compared to most other lakes perhaps due to lack of predators. For the colonizable 0-12 m depth interval and the total lake it was 96.2 g/sq m including shells, respectively. Biomass of plants and animals was even higher prior to the recent including shells, respectively. Biomass of plants and animals was even higher prior to the recent lowering of the water level by 7 m, which was estimated to have stranded 84,000 tons of mussels on the shore. The historic development of the fauna and flora after closure of the dam in 1958 is discussed, together with factors which today determine the distribution of benthic communities. (Author's abstract) W88-08074

EFFECTS OF NUTRIENT (N, P, C,) ENRICH-MENT UPON PERIPHYTON STANDING CROP, SPECIES COMPOSITION AND PRI-MARY PRODUCTION IN AN OLIGOTRO-PHIC SOFTWATER LAKE. West Chester Univ. of Pennsylvania. Dept. of Biol-

ogy, G. W. Fairchild, and A. C. Everett. Freshwater Biology FWBLAB, Vol. 19, No. 1, p 57-70, February 1988. 7 fig. 3 tab, 49 ref. NSF Grant BSR-8415774.

Descriptors: *Algal growth, *Nutrients, *Periphyton, *Water pollution effects, *Primary productivity, *Biomass, *Limnology, *Nitrogen, *Phosphorus, *Carbon, *Enrichment, *Oligotrophic lakes, Species composition, Light quality, Algae, Lakes, Lake Lacawac, Standing crops.

Algal periphyton communities are highly sensitive to changing nutrient supply within lake systems. The effects of nutrient addition upon algal periphy-ton standing crop and benthic community metaboton standing crop and benthic community metabo-lism were investigated in Lake Lacawac, Pennsyl-vania. Nutrient-diffusing flower pot substrates were filled with combinations of P, N and carbon as glucose or NaHCO3 (C). Fifty-two pots repre-senting ten treatments were placed in the lake on 5 May 1985 and sampled after 32-38 days. Maximum chlorophyll-a values of 23.82 micrograms/sq cm and 29.72 micrograms/sq cm were obtained on NPC (nitrogen/phosphorus/bicarbonate) and NPHG (nitrogen/phosphorus/high glucose) pots respectively, compared to 0.82 micrograms/sq cm on control pots. Algal growth was not enhanced unless N and either organic or inorganic carbon were supplied. Gross production, net production were supplied. Gross production, net production and community respiration were assessed with light-dark chambers affixed to the pots using microwinkler measurements of dissolved oxygen. Highest production rates were obtained on NC and NPC pots. Pots with NPLG (nitrogen/phospho-rus/low glucose) and NPHG also showed significant increases in gross production compared to control levels. Specific production (= gross procontrol levels. Specific production (= gross production/chlorophyll-a) was significantly related to standing crop as chlorophyll-a, alkalinity in the chambers and light but not to N or P. The periphyton community was dominated by Chlorophyta, which averaged 86.1% of total algal biovolume. Enrichment with NC and NPC significantly enhanced the growth of three Chlorophyceae and two Cryptophyceae. In contrast, the filamentous

green alga Mougeotia dominated other treatments, but declined significantly with NPC enrichment. Addition of NPHG stimulated an 8-fold increase in total biovolume and significant increases in growth of Cryptomonas, Rhodomonas and Euglena. Lake Lacawac is an oligotrophic, softwater lake with mid-summer concentrations of 36 micro-mol/L total N, 0.8 micro-mol/L total P and < 0.04 meg/L alkalinity. Under these conditions, enrichment with any one nutrient is apparently insufficient to substantially affect periphyton growth. (Alexander - PTT) PTT) W88-08075

SUBMERGED AQUATIC MACROPHYTE BIOMASS IN RELATION TO SEDIMENT CHARACTERISTICS IN TEN TEMPERATE LAKES, McGill Univ., Montreal (Quebec). Dept. of Biol-

ogy. M. R. Anderson, and J. Kalff. Freshwater Biology FWBLAB, Vol. 19, No. 1, p 115-121, February 1988. 2 fig, 2 tab, 39 ref.

*Biomass, *Lakes. plants, *Temperature zone, *Macrophytes, *Sediments, Limnology, Cycling nutrients, Species composition, Potassium, Phosphorus, Nitrogen, Nutri-

This study links maximum biomass from eighteen aquatic macrophyte communities in the Eastern Townships of Quebec, Canada, to sediment characteristics: chemically exchangeable nitrogen, phosphorus and potassium, per cent organic matter, water content and texture, and to biotic variables: number of species and depth of maximum biomass. Total biomass was positively and significantly related to sediment potassium content and to sediment texture. Sediment nitrogen and potassium levels are correlated in the spring but not at the end of the growing season. It appears that sediment potassium is a surrogate variable for the availabil-ity of sediment nitrogen which has been shown to limit aquatic macrophyte growth in this area. (Au-thor's abstract) W88-08076

ZOOPLANKTON FEEDING RATES IN RELA-TION TO SUSPENDED SEDIMENT CONTENT: POTENTIAL INFLUENCES ON COMMUNITY STRUCTURE IN A TURBID RESERVOIR,

Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.

R. C. Hart. Freshwater Biology FWBLAB, Vol. 19, No. 1, p 123-139, February 1988. 5 fig, 5 tab, 45 ref.

Descriptors: *Feeding, *Suspended sediments, *Reservoirs, *Turbidity, *Optical properties, *Zooplankton, *Species composition, Biomas, Lake le Roux, Radioactive tracers, Limnology, Food habits, Aquatic habitats, Aquatic at Lakes, South Africa.

Changes in zooplankton composition and abundance in Lake le Roux, a turbid subtropical reservoir on the Orange River in South Africa, were correlated with changes in water transparency (revoir on the Orange River in South Africa, were correlated with changes in water transparency (re-lated to suspended sediment levels) during a 7 year field study. Results of radiotracer studies of the effect of mineral turbidity threshold at which food effect of mineral turbidity threshold at which food intake matched the estimated respiratory need was derived for each species. The consistency between this ranking and one based upon abundance-transparency relationships in the field study suggests that community structure is related to differential feeding capabilities, although other influences are not excluded. Tests on Daphnia gibba and Metadiaptomus meridianus failed to reveal any detectable feeding rate saturation (incipient limiting food level) below 1.2 mg C/L. The relative reduction in feeding rates at elevated turbidity was nearly 3 times greater for the daphnid than the copenod times greater for the daphnid than the copepod over a range of food concentrations, and considerover a range of tood concentrations, and consider-ably reduces the competitive ability of this (and other) daphnids. The turbidity tolerance disparity between Moina brochiata and the daphnids demon-strates a more complex situation than a simple copepod/cladoceran dichotomy. These findings and their implications are discussed in relation to wider features of zooplankton ecology. (Author's

DISTRIBUTION OF EPHEMERELLA IGNITA (EPHEMEROPTERA) IN STREAMS: THE ROLE OF PH AND FOOD RESOURCES, Biological Association,

(England). L. G. Willoghby, and R. G. Mappin. Freshwater Biology FWBLAB, Vol. 19, No. 2, p 145-155, April 1988. 9 fig, 4 tab, 20 ref.

Descriptors: *Mayflies, *Acid streams, *Water chemistry, *Aquatic animals, *Hydrogen ion concentration, *Food habits, Limnology, Animal physiology, Aquatic habitats, Comparison studies, Alkaline water, Catchment areas, Ions, Streams.

The mayfly Ephemerella ignita does not occur in upland streams of the River Duddon catchment which have waters with low pH values of 4.8-5.2, negative alkalinities and low ionic contents. However, it does occur in lowland streams of the catchment which have waters with higher pH catchment which have waters with higher pH values of 6.6 and above, large positive alkalinities and high ionic contents. This study addresses the question of whether the absence of the animal in the acid water streams is due directly to the water chemistry or to the absence of suitable food. In comparative experiments using unfed animals of several species it is shown that E. ignita has a considerable tolerance of low pH, low ion water. In this it is similar to Amphinemura sulcicollis (Plecoptera), a stonelly which occurs in the acid water streams of the River Duddon catchment. In this it is similar to Amphinemura sulcicollis (Plecoptera), a stonefly which occurs in the acid water streams of the River Duddon catchment. Growth rates in laboratory experiments with E. ignita were equally good whether the food supplied was that available in the low pH water streams or typical of that available in high pH water streams. However, a consideration of the natural habits of the animal suggests that it is the inaccessibility of the Hormidium sebtile algal food, rather than its unsuitability, which is relevant to the exclusion of E. ignita from the low pH streams. In addition, the very limited diversity of other algae in the low pH water streams, in the summer season, may well be influential in inhibiting the establishment of E. ignita. The comparative experiments using unfed animals suggested that, contrary to the findings for E. ignita, the mayflies Baetis muticus and Baetis rhodani are probably excluded from the acid water streams of the Upper Duddon because of water chemistry. (Author's abstract) W88-08078

CHEMICAL ECOLOGY OF SOME BRITISH FRESHWATER GASTROPOD MOLLUSCS: BE-HAVIORAL RESPONSES TO SHORT CHAIN CARBOXYLIC ACIDS AND MALTOSE,

Sussex Univ., Brighton (England). School of Biological Sciences.

logical sciences. P. W. G. Daldorph, and J. D. Thomas. Freshwater Biology FWBLAB, Vol. 19, No. 2, p 167-178, April 1988. 10 fig. 44 ref. SERC Grants T16/181.B22 and GRD51239.

Descriptors: *Chemoreception, *Gastropods, *Fatty acids, *Mollusks, *Snails, *Animal behav-ior, *Organic compounds, *Food habits, Hydrogen ion concentration, Ecological effects, Nutrients, Eutrophication, Decomposing organic matter.

The behavioral responses of six species of British freshwater gastropods to chemical gradients of short chain carboxylic acids (C-2 to C-5, C-8) and maltose were investigated by means of diffusion olfactometers. The species were ranked as follows on the basis of the number of significant behavioral differences in activity but reflect real differences in chemoreception. Propanoate (C-3) was a significant attractant or arrestant to five snail species, C-4, C-8 and maltose to four species and C-5 to three species. Acetate (C-2) was a significant attractant of L. peregra and P. fontinalis but it was the only acid to act as a repellent, to P. planorbis and B. tentaculata. Lymnaea peregra continued to re-

spond to repeated butanoate application. Response levels could be enhanced by increasing concentration, pH and food deprivation. The ecological relevance of the results are discussed with particular reference to the distributional patterns of the chemicals and snails and the feeding niches of the latter. (Author's abstract) W88-08079

ALKALINITY AND PH OF TARNS AND STREAMS IN THE ENGLISH LAKE DISTRICT (CUMBRIA). Freshwater Biological Association, Windermere

(England).

D. W. Sutcliffe, and T. R. Carrick.

Freshwater Biology FWBLAB, Vol. 19, No. 2, p 179-189, April 1988. 4 fig. 2 tab, 60 ref, append.

Descriptors: *Acidic water, *Acid rain, *Acidification, *Alkaline water, *Limnology, *Hydrogen ion concentration, *Acid streams, *Water chemistry, Catchment areas, Seasonal variation, England, Tarns, Cumbria, Lakes, Ponds, Streams, Geologic

The distribution of softwater and acid tarns and streams in central Cumbria is briefly summarized and compared for the periods 1983-85 and 1949-56. Fifty-three upland tarns and forty lowland tarns were sampled on Skiddaw Slates, the Borrowdale Volcanic Series, and igneous intrusions. On these bedrocks, tarns and streams would be highly sensitive to further acidification if acid deposition increases above current levels. Twenty-six upland and seven lowland tarns are permanently acid with zero or negative alkalinity values throughout the year; mean pH ranged from 5.3 to 4.2. The other sixty upland and low land tarns had positive mean alkalinity (Alk) in the summers of 1983-85, ranging from 7 to 1227 micro-equiv/L alk and mean pH 5.7 to > 7.0. Thirty-one of the sixty tarns had mean Alk < 100 micro-equiv/L in summer (May-September); sixteen became temporarily acid (negative Alk) for varying periods in winter. Acid episodes also occurred in the tarns in 1949-56. Acid and very low alkalinity tarns and streams common-The distribution of softwater and acid tarns and episodes also occurred in the tarns in 1949-56. Actu and very low alkalinity tarns and streams common-ily occur on the high western, central and northern fells. Few occur on the high eastern fells, where there are veins of calcite in exposed rocks. Seven-fer leveland tarns were sampled on Silurian there are veins of calcite in exposed rocks. Seventy-five lowland tarns were sampled on Silurian Slates in southern Lakeland. On these bedrocks, tarns and streams are not highly sensitive to further acidification. Only six tarns had summer mean Alk < 100 micro-equiv/L. No permanently acid tarns or streams were found. Over a mean span of about 30 years, Eel Tarn appears to have become slightly more acid and Harrop Tarn slightly less acid. The remainder of all tarns surveyed in 1983-85 have altered little, although there is a heavy load of acidic deposition onto the catchments and some tarns contain very low concentrations of Alk. tarns contain very low concentrations of Alk. Rapid acidification in recent years has been prevented by the neutralizing capacity of volcanic and sedimentary rocks. These rocks produce relatively high concentrations of Alk, up to 650 micro-equiv L in some spring-fed streams on the central fells and even more at lower altitudes. Absence of coniferous forest on the higher ground may be an important additional reason for the very slow rate of acidification in Cumbrian waters. (Author's abstract) W88-08080

MODERN DIATOM ASSEMBLAGES IN CENTRAL MEXICO: THE ROLE OF WATER CHEMISTRY AND OTHER ENVIRONMENTAL FACTORS AS INDICATED BY TWINSPAN AND DECORANA, Stirling Univ. (Scotland). Dept. of Environmental

Science

For primary bibliographic entry see Field 5C. W88-08082

EFFECTS OF LOW PH AND HUMUS ON THE SURVIVORSHIP, GROWTH AND FEEDING OF GAMMARUS PULEX (L.) (AMPHIPODA), Lund Univ. (Sweden). Dept. of Ecology. For primary bibliographic entry see Field 5C. W88-08083

INFLUENCE OF FISH ON LEAF BREAK-DOWN IN A VIRGINIA POND, Virginia Polytechnic Inst. and State Univ., Blacks-

burg. Dept. of Biology. F. Taylor, and A. C. Hendricks.

Freshwater Biology FWBLAB, Vol. 18, No. 1, p 45-51, August 1987. 2 fig, 2 tab, 18 ref.

Descriptors: *Fish, *Leaf breakdown, *Leaves, *Ponds, Fish behavior, Virginia, Sunfish, Catfish, Microbial degradation, Biodegradation.

To find if fish affect leaf breakdown, sugar maple leaves (Acer sacchrum March) were placed in a soft-water, farm pond at a depth of 1 m for up to 3 sort-water, larm pond at a depth of 1 m tor up to 3 months in four treatment groups: (1) enclosure with sunfish (Lepomis macrochirus Rafinesque; (SUNFISH treatment); (2) enclosure with catfish (Ictalurus punctatus Rafinesque)(CATFISH treatment); (3) enclosure without fish (No FISH treatment); and (4) no enclosure (OPEN treatment). The study was conducted in societa and automatical study and control of the study was conducted in societa and automatical study. ment); and (4) no enclosure (OPEN treatment). The study was conducted in spring and autumn. The leaf breakdown rates, k + or - 95% CL, for SUNFISH (0.0082 + or - 0.00059 and 0.0111 + or - 0.00162/day) and CATFISH (0.0072 + or - 0.00096 and 0.0103 + or - 0.00077/day) were greater in spring and summer, respectively, than in the OPEN treatments (0.0065 + or - 0.00048 and 0.0105 + or - 0.00048 and 0.0105 + or - 0.00049/day). However, only breakdown rates for SUNFISH was significantly different from NO FISH and OPEN treatments. Fish in the pond did not appear OPEN treatments. Fish in the pond did not appear to affect breakdown rates of OPEN leaf packs in the first replicate but leaf breakdown rates ap-proached that of the fish treatments in the second replicate. Fish may have promoted leaf breakdown directly by fragmentation of leaves while foraging for food and, indirectly, by agitation of leaves leading to increased microbial activity. (Author's abstract)

COLONIZATION AND ECOLOGICAL DEVEL-OPMENT OF NEW STREAMS IN GLACIER BAY NATIONAL PARK, ALASKA, Chelsea Coll., London (England). Dept. of Biolog-

ical Sciences

A. M. Milner.

Freshwater Biology FWBLAB, Vol. 18, No. 1, p 53-70, August 1987. 4 fig, 8 tab, 68 ref.

Descriptors: *Freshwater populations, *Streams, *Invertebrates, *Fish, *Glacial streams, *Ecology, Alaska, Water temperature, Temperature effects, Salmon, Streamflow, Sedimentation, Midges, Aquatic populations, Population dynamics, Succession, Insects, Organic matter, Detritus, Snowmelt.

Colonization and ecological development of postcolonization and ecological development of post-glacial freshwater communities were investigated in Glacier Bay National Park, south-eastern Alaska, following the rapid recession of a Neo-glacial ice sheet within the last 250 years. Environ-mental variables shown to be most significant in stream development were temperature, flow regime and sedimentation. The Chironomidae (Diptera) were the pioneer invertebrate colonizers of newly emergent streams arising as meltwater from receding ice sheets and displayed a distinct pattern of succession with stream maturity. Ephemeroptera and Plecoptera colonized warmer clear-water streams, but Trichoptera had a minimal role in invertebrate community development. Establishment and production of salmonid fish populations in the new streams related principally to stream flow and sediment characteristics. Future path-ways along which the streams may develop is probably dependent on the degree of large organic probably dependent on the degree of large organic debris input. Stream development, structure and function are summarized including references to theories of ecosystem development, ecological suc-cession and community stability. (Author's abstract) W88.08095

RELATIONSHIPS BETWEEN BATHYMETRY, WATER QUALITY AND DIATOMS IN SOME HEBRIDEAN LOCHS,

University Coll., London (England). Palaeoeco-

Group 2H—Lakes

logy Research Unit. R. J. Flower, and A. J. Nicholson. Freshwater Biology FWBLAB, Vol. 18, No. 1, p 71-85, August 1987. 5 fig. 7 tab, 35 ref, append.

Descriptors: "Bathymetry, "Lake morphometry, "Lakes, "Water quality, "Path of pollutants, "Diatoms, Limnology, Chemical properties, Computers, Scotland, Salts, Calcium, Sulfates, Nitrates, Multivariate analysis, Correlation analysis, Conductivity, Sediments, Statistical analysis.

Computer methods for mapping and calculating morphometric characteristics are described and ap-plied to seventeen previously unsurveyed South Uist lochs. Deposited sea salt is shown to have a Usst locks. Deposited sea sait is shown to have a major effect on water quality and the effect varies according to the distance from the west coast. Calcium concentrations appear to be determined by dissolution of locally abundant shell debris. Sulfate and particularly nitrate concentrations are Sulfate and particularly nitrate concentrations are influenced significantly by catchment sources. Surface sediment diatom assemblages from all seventeen sites are analyzed using multi-variate statistics software, DECORANA and TWINSPAN. Assemblages are shown to be clearly distributed along DECORANA axis I and are clustered into five groups by TWINSPAN. Correlation analysis of water quality, morphometric characteristics and DECORANA axes scores indicates that conductivity has the strongest influence on surface sediment diatom assemblage composition whereas morphometric characteristics have no demonstrable effect. (Author's abstract) ble effect. (Author's abstract) W88-08096

DIVERSITY OF MACROINVERTEBRATE AND MACROPHYTE COMMUNITIES IN PONDS, Exeter Univ. (England). Dept. of Biological Sci-

E. E. Friday. Freshwater Biology FWBLAB, Vol. 18, No. 1, p 87-104, August 1987. 5 fig, 5 tab, 43 ref.

Descriptors: *Macroinvertebrates, *Macrophytes, *Populations, *Ponds, *Acidic water, Population density, Aquatic populations, Regression analysis, Hydrogen ion concentration, Chemical properties,

Factors explaining the variation in numbers of macroinvertebrate and macrophyte taxa in pond communities were investigated using multiple regression analysis for 16 ponds in England for which biogeographical effects were likely to be minimal. For each water sample, pH, electrical conductivity, turbidity, total hardness, alkalinity, conductivity, turiously, total nardness, attannity, orthophosphate concentration and 5-day biological oxygen demand were determined the day of collection; later, 7 samples were analyzed for calcium concentration and 2 were analyzed for total aluminum. concentration and 2 were analyzed for total alumi-num. Water temperature and dissolved oxygen were measured in all ponds in situ. Numbers of macroinvertebrate taxa in these ponds were highly correlated with pH and probably, therefore with other associated aspects of water chemistry. Many invertebrate taxa, from species to entire phyla, were not found below pH 5.5, but few characteris-ically 'acidochilic' teas uses assessed. Details were not found below pH 3.2, but rew characteristically 'acidophilic' taxa were apparent. Details of species composition of the macroinvertebrate fauna differ widely even between ponds of similar pH. The diversity and composition of macrophyte communities are not adequately predicted by any of the factors investigated. (Wood-PTT)

ROLE OF DRIFT AND EFFECT OF SEASON ON MACROINVERTEBRATE COLONIZATION OF IMPLANTED SUBSTRATA IN A TROPICAL AUSTRALIAN STREAM,

James Cook Univ. of North Queensland, Towns-ville (Australia). Dept. of Zoology. L. J. Benson, and R. G. Pearson. Freshwater Biology FWBLAB, Vol. 18, No. 1, p 109-116, August 1987. 2 fig, 2 tab, 18 ref.

Descriptors: *Macroinvertebrates, *Population dynamics, *Streams, *Tropical regions, Drift, Season-al variation, Australia, Habitats, Population densi-ty, Populations, Aquatic populations, Benthic fauna.

Experiments using implanted substrata were conducted in Yuccabine Creek, an upland stream in north-eastern Australia which exhibits a strong seaducted in Yuccabine Creek, an upland stream in north-eastern Australia which exhibits a strong seasonal pattern of discharge and temperature. The implanted substrata were either set in the stream bed or were raised in the water column. Three experiments were run, at different times of the year. Colonization rate was dependent on benthic abundance, mobility of the fauna and distribution of resources. The rates on embedded trays were similar in the late wet season and mid dry season, but colonization rate in the late dry season was greater. Drift alone could have accounted for all colonization in the late wet season, 63% of colonization in the mid dry season and less (ummeasured) in the late dry season and less (ummeasured) in the late dry season and less (ummeasured) in the late dry season peak in reproduction. Following the wet season, stream discharge decreases, benthic abundance increases, resources become more concentrated, and movements of animals in contact with the substratum play an increasingly important role in colonization. (Author's abstract) W88-08098

SIZES AND DAILY GROWTH RATES OF TWO ALGAL PHYTOPLANKTERS IN THE FIELD, Centro de Investigaciones del Agua, Madrid

(Spain). M. Alvarez Cobelas, J. L. Velasco, A. Rubio, and F. J. Acosta

Freshwater Biology FWBLAB, Vol. 18, No. 1, p 125-134, August 1987. 6 fig, 4 tab, 21 ref.

Descriptors: *Limnology, *Algae, *Algal growth, *Chlorophyta, Population dynamics, Eutrophication, Reservoirs, Madrid, Spain, Phytoplankton, Aging, Aquatic population

Aging, Aquatic populations.

Measurements of daily growth rates, colony widths and lengths and cell widths and lengths were made on Fotterella tetrachlorelloides Buck and Staurastrum longiradiatum West & West (Chlorophycae), collected from an eutrophic reservoir close to Madrid (Spain) on nine consecutive days of June 1983. F. tetrachlorelloides exhibited growth followed by a period of decay, while S. longiradiatum grew more or less continuously throughout the observations. A colony lengthwidth relationship was statistically significant in the proposition of F. tetrachlorelloides, but not when the population was decaying. This relationship was always statistically significant in S. longiradiatum. There was an inverse relationship between volume and daily growth rate in S. longiradiatum, but no such correlation was found in F. tetrachlorelloides. The time course of statistical volume distributions and daily growth rates suggested that F. tetrachlorelloides was undergoing clonal ageing during the study. (Author's abstract)

SOLAR HEATING AND ITS INFLUENCE ON MIXING IN ICE-COVERED LAKES, Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics. P. C. Matthews, and S. I. Heaney. Freshwater Biology FWBLAB, Vol. 18, No. 1, p 135-149, August 1987. 4 fig, 5 tab, 33 ref, append.

Descriptors: *Limnology, *Solar radiation, *Iced lakes, *Thermal stratification, *Density stratification, *Destratification, Mathematical models, Mixing, Lakes, Model studies, Mathematical equations, Convection, Vertical distribution, Temperature gradient, Temperature, Diffusivity, Radiation, Model testing, Canada, Antarctica.

The influence of solar heating on the formation of temperature and density profiles of ice-covered lakes is important and can provide the driving lakes is important and can provide the driving energy for penetrative convection under certain conditions. Mathematical models were derived to quantify the effect of solar heating on vertical stability and its dependence on the temperature, temperature gradient, diffusivity, radiation intensity, and extinction coefficient. The factors which make a lake likely to mix due to solar heating are:

(1) high solar radiation input; (2) high extinction coefficient; (3) low initial temperature; (4) low

density stratification due to temperature gradient or dissolved substances; and (5) low vertical eddy diffusivity. The models were applied to Babine Lake, British Columbia, and two other ice-covered lakes, Heywood Lake and Sombre Lake in Antarclakes, Heywood Lake and Somore Lake in Amarcica, for which the necessary physical data were available, to assess whether the observed temperature profiles and mixing could be caused by solar heating. The importance of convective mixing was discussed in relation to the distribution of phytoplankton and nutrients. (Wood-PTT) W88-08100

LAKE SEDIMENT MICROLAMINAE AND ANNUAL MORTALITIES OF PHOTOSYNTHETIC BACTERIA IN AN OLIGOMICTIC LAKE,

Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.

For primary bibliographic entry see Field 2J. W88-08101

TEMPERATURE-INDUCED CHANGES IN THE LIFE CYCLE OF LEUCTRA NIGRA (PLE-COPTERA: LEUCTRIDAE) FROM A LAKE DISTRICT STREAM.

Freshwater Biological Association, Ambleside

J. M. Elliott.

Freshwater Biology FWBLAB, Vol. 18, No. 1, p 177-184, August 1987. 4 fig, 2 tab, 18 ref.

Descriptors: *Stoneflies, *Aquatic insects, *Tem-perature effects, *Life cycles, *Streams, Water temperature, Temperature, England, Larvae, Larval growth stage, Growth stages, Mortality.

The life cycle of the stonefly, Leuctra nigra, may be univoltine (lasting one year) or semivolfine (lasting two years). Stoneflies had a two-year life cycle in a small stream in the English Lake District and the exponential growth of the larvae was scarcely affected by variations in water temperature in the range of 42-14.0 degrees C. Larval growth and mortality were exponential at six constant temperatures ranging between 5.9 and 19.8 degrees C in the laboratory. Mean growth rates (% body length/day) increased directly with temperature from 0.37 (5.9 degrees C) to 0.55 (19.8 degrees C). Mean mortality rates (%/day) increased directly of the constant of the cons ture from 0.37 (5.9 degrees C) to 0.55 (19.8 degrees C). Mean mortality rates (%/day) increased directly with temperature from 0.20 (5.9 degrees C) to 0.26 (12.1 degrees C) and then markedly increased to 0.54-0.58 at the three higher temperatures (15.8-19.8 degrees C). Only 7-10% of animals completed their life cycle at the three higher temperatures compared with 23-27% at the three lower temperatures (5.9-12.1 degrees C). Egg production also decreased considerably at the higher temperatures. Since growth rates in the stream and laboratory were similar at similar temperatures below 14 degrees C, the optimum conditions for growth in the stream; therefore, resources such as food and space were not restricting growth in the stream. The implication of the temperature-induced changes in were not restricting growth in the stream. The implication of the temperature-induced changes in growth and mortality are discussed and it is concluded that although the life cycle can change from semivoltine to univoltine with increasing temperature, the costs of a univoltine life cycle are high in terms of survival and egg production, both of which decreased markedly between 12.1 and 15.8 degrees C. Therefore, the optimum habitat for this species appears to be a summer cool stream with a maximum temperature of less than 14 degrees C and the optimal life cycle appears to be about 2 years from egg to adult. (Wood-PTT) W88-08102

TIME SERIES ANALYSIS OF WATER QUALITY DATA FROM LAKE ONTARIO: IMPLICATIONS FOR THE MEASUREMENT OF WATER QUALITY IN LARGE AND SMALL

Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.

Freshwater Biology FWBLAB, Vol. 18, No. 3, p 389-403, December 1987. 7 fig, 3 tab, 28 ref.

Lakes-Group 2H

Descriptors: *Water quality, *Time series analysis, *Lake Ontario, *Water sampling, *Lakes, *Monitoring, Sampling frequency, Sampling, Variances, Advection, Biological properties, Physical proper-

The normal strategy of monitoring water quality is to sample such parameters as chlorophyll no more than weekly. A preferable strategy is to first define the natural periodicities in the water body and then set up a sampling scheme that takes into account the natural scales of variance in physical, chemical and biological parameters. Failure to do so leads to aliased and biased estimates of means and variances and an inability to interpret the underlying physical and biological mechanisms. The natural scales of variance vary with basin size. In lakes, physical and biological processes overlap at scales of 1 to 15 days. Times series analysis of daily data from Lake Ontario and other lakes showed how the means and variances of the data sets were determined by Critario and other takes showed how the means and variances of the data sets were determined by the physical and biological processes in the water columns, and displayed the fundamental lags in the systems. Even in small lakes and reservoirs, advections and the systems of the systems of the systems of the systems. systems. Even in small lakes and reservoirs, advective processes were of great importance. Advection became the dominant process in Lake Ontario. Time lags and advection made simple correlation of physical and biological parameters meaningless. Decimation of the daily data sets revealed the statistical dangers of less frequent sampling. The desirable frequency of sampling was shown to be a function of the physics of the mixed layer, the turnover times of the nutrient pools, and the biological activity. Data from the three lakes graphically demonstrated the inadequacy of normal sampling frequencies. (Author's abstract) W88-08103

MICROBIAL ACTIVITY ASSOCIATED WITH SESTON IN HEADWATER STREAMS: EF-FECTS OF NITROGEN, PHOSPHORUS AND TEMPERATURE, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept of Biology.

burg. Dept. of Biology. G.T. Peters, J. R. Webster, and E. F. Benfield. Freshwater Biology FWBLAB, Vol. 18, No. 3, p 405-413, December 1987. 5 tab, 46 ref.

Descriptors: *Nutrients, *Ecology, *Microbial activity, *Microbiological studies, *Seston, *Suspended solids, *Organic matter, *Particulate matter, Water pollution effects, Nitrates, Phoschates, Temperature effects, Water temperature, Temperature, Headwaters, Streams, Appalachian Mountains, Nutrients, Mineralization.

The influences of temperature and dissolved nitrates and phosphates on microbial activity associated with suspended fine particulate organic matter (seston) were evaluated in four headwater streams in the southern Appalachian Mountains. Temperature manipulations of plus or minus 5 degrees C always induced significant changes in C14-glucose mineralization (ANOVA; P<0.05) and H3-thymidine incorporation (ANOVA; P<0.05). Nutrient amendments of 1.0 mg NO3/liter and 0.05 mg PO4/liter induced no significant alterations in bacterial mineralization of C14-glucose (ANOVA; P>0.05) or incorporation of H3-thymidine (ANOVA; P>0.05) in short-term (i.e. 3 hour) experiments. Microorganisms attached to refractory particulate organic matter did not appear to be limited by nitrogen or phosphorus even in streams with ambient nutrient concentrations as low as 0.06 mg NO3/liter and <0.03 mg PO4/liter. The results indicate that variations in water temperature fluctuations, forest clear-cutting, and catchment flevation and aspect can have market effects upon The influences of temperature and dissolved nifluctuations, forest clear-cutting, and catchment elevation and aspect can have marked effects upon microbial activity and production, while shortterm alterations in nutrient regime appear to have no significant effect on microbial activity associated with seston. (Author's abstract) W88-08104

VERTICAL PARTITIONING OF THE PHYTO-PLANKTON ASSEMBLAGE IN ULTRAOLIGO-TROPHIC CRATER LAKE, OREGON, U.S.A., Army Engineer District, Portland, OR.
D. W. Larson, C. N. Dahm, and N. S. Geiger.
Freshwater Biology FWBLAB, Vol. 18, No. 3, p

429-442, December 1987. 7 fig. 5 tab, 40 ref.

Descriptors: *Phytoplankton, *Vertical distribu-tion, *Ultraoligotrophic lakes, *Limnology, *Oli-gotrophic lakes, *Crater Lake, Oregon, Population density, Distribution patterns, Spatial distribution, Plankton, Populations, Biomass, Primary produc-tivity, Diatoms.

At 589 meters, Crater Lake, Oregon, ranks at the deepest lake in the United States, and the seventh deepest in the world. The summertime phytoplankton assemblage consists of over 100 species, which are variously distributed in the upper 200 m of the vertical water column. The depth distribution of vertical water column. The depin distribution the lake's three most prevalent species follows a predictable pattern: Nitzschia gracilis in the 0-20 m stratum, Tribonema sp. at mid-depth (80-120 m), and Stephanodiscus hantzschii in the lowermost and Stephanodiscus hantzscmi in the lowermost stratum (160-200 m). These major species, which account for approximately 80% or more of the lake's total phytoplankton biomass and primary production, exist under atypical temperature, light and nutrient conditions. The spatial distribution of phytoplankton in Crater Lake resembles a threephytoplankton in Crater Lake resembles a three-tier structure. Unlike most lakes, where the entire phytoplankton communities exist in less disparate environmental conditions, or are vertically mixed periodically by storm events and seasonal lake turnover, the Crater Lake community is parti-tioned into stratified environments. The disparate and unusual characteristics of these environments, the hydrological and limnological stability of the lake basin, are perhaps important factors regu-lating the diversity, dominance, and partitioning of the lake's phytoplankton populations. (Author's abstract) W88-08106

ATE HOLOCENE FLOODING IN THE ECUA-

DORIAN RAIN FOREST, Ohio State Univ., Columbus. Dept. of Zoology. For primary bibliographic entry see Field 2E. W88-08107

GROWTH RATE OF THE AQUATIC MOSS RHYNCHOSTEGIUM RIPARIOIDES IN NORTHERN ENGLAND,

Durham Univ. (England). Dept. of Botany. M. G. Kelly, and B. A. Whitton. Freshwater Biology FWBLAB, Vol. 18, No. 3, p 461-468, December 1987. 3 fig. 4 tab, 31 ref.

Descriptors: *Lakes, *Wetlands, *Limnology, *Plant growth, *Mosses, *Growth rates, *Aquatic plants, Seasonal variation, England, Northern Pennines, Growth, Temperature effects, Temperature, Water temperature, Precipitation, Regression anal-

The rate of shoot growth in Rhynchostegium ri-The rate of shoot growth in Rhynchostegium ri-parioides was measured at monthly intervals over a 12-month period at four upland sites in the North-ern Pennines. Changes were recorded by observa-tions on attached pieces of cotton. Detectable growth was found in each month, with maximum in spring (up to 2.31 mm/week) and minimum in winter (1.12 mm/week); there was a second smaller peak in the autum. Growth rate was related strongly to several environmental variables, including spot measurements of water temperature (positive) and mean monthly precipitation (negative). A regression equation based on these two variables accounted for 58% of the variation recorded. The growth rate did not sense to be corded. The growth rate did not appear to be affected by heavy metals. Total shoot growth over the 12-month period ranged from 33.4 to 63.3 mm, corresponding to an increase in mass of 22.9 and 120.8 mg, respectively. (Author's abstract) W88-08108

SPATIAL DISTRIBUTION OF TRICHOPTERA LARVAE IN THE SEDIMENTS OF AN AUSTRIAN MOUNTAIN BROOK,

Vienna Univ. (Austria). Zoologisches Inst. J. A. Waringer. Freshwater Biology FWBLAB, Vol. 18, No. 3, p 469-482, December 1987. 3 fig, 7 tab, 42 ref,

Descriptors: *Caddisflies, *Larvae, *Distribution patterns, *Sediments, *Streams, Bottom sediments, Aquatic insects, Austria, Life cycles, Spatial distri-bution, Distribution, Particle matter, Organic bution. matter, Biological samples.

A set of thirty-six permanently installed standpipe A set of thirty-six permanenty instance standpipe traps was used over 2 years to sample caddis larvae at various depths in the gravel bed of an Austrian brook. From a total of 805 specimens caught, the most abundant species were Sericostoma sp (Seri-costomatidae), and the three limnephilids Potamo-balde significants. Steph. Allegams. phylax cingulatus Steph., Allogamus auricollis Pictet and Allogamus uncatus Brauer. Sericostoma sp. and Ecclisopteryx guttulata Pictet were collected down to a sediment depth of 1 m. In Sericostoma sp., a burrowing species, tiny larvae were found in sediments at 20-60 cm, where most of the tound in sediments at 20-60 cm, where most of the life cycle is spent; fully grown laryae were mostly collected at a depth of 0-20 cm. All instars of Potamophylax cingulatus, Allogamus auricollis and Allogamus uncatus laryae were most abundant at the sediment surface. The horizontal distribution of the most abundant species was studied at the 20 cm depth stratum. Larvae were most abundant in midstream areas. Factors discussed as probably responsible for the observed spatial distribution pattern included vertical and horizontal water flows within the sediments which supply the sediment dwellers with oxygen and food, particulate organic matter concentration variations, and prey density. Water temperature, chemical factors and oxygen were concluded to be unimportant in determining spatial distribution patterns since the range of these parameters was small at the study site. (Wood-PTT) W88-08109

EVIDENCE FOR THE USE OF NON-DETRI-TAL DISSOLVED ORGANIC MATTER BY MI-CROHETEROTROPHS ON PLANT DETRITUS IN A WOODLAND STREAM,

Georgia Univ., Athens, Inst. of Ecology, J. C. Miller.

Freshwater Biology FWBLAB, Vol. 18, No. 3, p 483-494, December 1987. 1 fig, 3 tab, 57 ref.

Descriptors: "Heterotrophic bacteria, "Dissolved solids, "Organic matter, "Streams, "Detritus, Microheterotrophs, Litter, Biomass, Bacteria, Fungi, Aquatic fungi.

Recent studies provide evidence for the use of exudates from living plants by epilithic microheter-otrophs in streams. The possible use of such non-detrital sources of dissolved organic matter (DOM) by stream microheterotrophs colonizing leaf litter was investigated. Biomass of bacteria and of fungi was investigated. Biomass of oacteria and of fungi accumulating in situ on autumn-shed leaves in flow-through troughs from which light was ex-cluded was compared to that accumulating on leaves in troughs open to natural illumination. In experiments repeated at different times of the year and in different stream sections, greater biomass of microheterotrophs consistently accumulated on the microheterotrophs consistently accumulated on the leaf detritus in troughs open to natural illumination. Differences in water temperature or in graz-ing of leaf surfaces by macroinvertebrates could not account for these consistent differences. Fur-ther, greater microheterotroph biomass accumulated on light- and dark-incubated leaves in a stream section relatively open to sunlight, compared to corresponding leaves in a section heavily shaded by canopy and understory vegetation. These and other results suggest that, to some yet undeter-mined extent, detritus-associated microheterotrophs use non-detrital DOM. This conclusion is consistent with a priori predictions based on consideration of microbial energetics involved in the use of detrital versus non-detrital DOM. Studies of trophic pathways in streams and other aquatic habitats have failed to assess some potentially im-portant sources of non-detrital DOM. The ability of available techniques to assess the relative roles of detrital and non-detrital sources of DOM is evaluated, and alternative approaches to this prob-lem are suggested. (Author's abstract) W88-08110

Group 2H-Lakes

ALTERATIONS IN PERIPHYTON CHARAC-TERISTICS DUE TO GRAZING IN A CASCADE STREAM.

STREAM, Washington Univ., Seattle. Dept. of Environmental Engineering and Science. J. M. Jacoby. Freshwater Biology FWBLAB, Vol. 18, No. 3, p 495-508, December 1987. 6 fig, 5 tab, 40 ref. NSF Grant CEE-83-04731.

Descriptors: *Periphyton, *Caddisflies, *Mayflies, *Larvae, *Streams, Biomass, Diatoms, Aquatic insects, Model studies, Accumulation, Washington,

In situ experiments were conducted in a Washington stream to quantify the effects of grazing by a caddisfly larva, Dicosmoecus gilvipes (Trichoptera: Limnephilidae), and a mayfly nymph, Nixe rosea (Ephemeroptera: Heptageniidae) on periphyton biomass, structure, and function. Dicosmoecus gilvipes reduced periphyton biomass from 92 mg/sq m (as mean chlorophyll a) to 33 mg/sq m. The grazed assemblage was less diverse and composed of smaller, closely attached diatoms, whereas there was a higher proportion of overstory and filamenof smaller, closely attached diatoms, whereas there was a higher proportion of overstory and filamentous algae in the diverse, ungrazed periphyton. By maintaining the periphyton community as a thin layer of diatoms, grazing D. gilvipes appeared to promote a healthier, more vigorous community relative to the ungrazed mat, which became sensecent in the latter part of the experiment. Nixe rosea had little measurable effect on any characteristics of the periphyton measured. These nymphs apparently preferred small diatoms, which resulted in only micro-scale alterations in periphyton characteristics that were difficult to detect. Biomass acrual of ungrazed and grazed periphyton was decread of ungrazed and grazed periphyton was deteristics that were difficult to detect. Biomass accrual of ungrazed and grazed periphyton was described by the logistic growth equation. Loss of biomass due to grazing by D. gilvipes or to senescence and sloughing were incorporated in the model to account for changes in grazed and ungrazed periphyton, respectively. Proposed mechanisms which described biomass accumulation were largely supported by model predictions. (Author's abstract) W88-08111

MACRO-FLORAL ASSEMBLAGES IN UPLAND WELSH STREAMS IN RELATION TO ACIDITY, AND THEIR IMPORTANCE TO INVERTEBRATES,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. J. Ormerod, K. R. Wade, and A. S. Gee.
Freshwater Biology FWBLAB, Vol. 18, No. 3, p
545-557, December 1987. 3 fig. 5 tab, 74 ref,

Descriptors: "Acidity, "Acid streams, "Acidic water, "Water pollution effects, "Macroflora, Invertebrates, Wales, Streams, Algae, Plant populations, Population density, Chemical properties, Hydrogen ion concentration, Aluminum, Macrophytes masses, Computer programs.

Macro-flora (angiosperms, bryophytes and macro-scopic algae) and macroinvertebrates were sampled in 1984 at eighty-eight sites on soft-water streams in upland Wales. Assemblage patterns were related to stream chemistry using TWIN-SPAN, DECORANA and multiple discriminants and the stream of the st analysis. Floral assemblages were related most strongly to pH and aluminum concentration, with Scapania undulata, Nardia compressa and filamen-tous chlorophytes characterizing streams of mean pH 5.2-5.8, while Fontinalis squamosa occurred mostly at pH 5.6-6.2 and Lemanea at pH 5.8-7.0. mostly at pH 5.6-6.2 and Lemanea at pH 5.8-7.0. An indicator system based on these taxa is proposed. Assemblages of invertebrates and flora concorded highly significantly, sites with Scapania and Nardia holding impoverished faunas. Because some acid sensitive invertebrates (e.g. Ecdyonurus and Ancylus) can feed from acid tolerant plants (e.g. Scapania), it is hypothesized that they are restricted physiologically from acid streams. (Author's abstract)

RELATION BETWEEN WAVE EXPOSURE AND DISTRIBUTION OF EMERGENT VEGETATION IN A EUTROPHIC LAKE,

Lund Univ. (Sweden). Dept. of Ecology. Freshwater Biology FWBLAB, Vol. 18, No. 3, p 537-544, December 1987. 4 fig, 3 tab, 26 ref.

Descriptors: *Plant populations, *Waves, *Distribution patterns, *Eutrophic lakes, Water depth, Littoral zone, Lakes, Sweden, Distribution, Spatial distribution, Biomass, Substrates.

Maximum water depth penetration and changes in horizontal distribution during 39 years of the emer-gent vegetation in a eutrophic lake in southern Sweden were investigated. The capacity of the emergent vegetation to penetrate into deeper water areas was higher at wave-exposed than at sheltered areas was mgner at wave-exposed than at sheltered sites. Differences in biomass and biomass allocation of the dominant species, Phragmites australis, be-tween an exposed and a sheltered site suggest that horizontal expansion towards deeper water at shel-tered sites is limited by unfavorable substrate con-ditions. (Author's abstract) WAR-DRILL

TOTAL BACTERIAL CELL COUNTS AND ESTERASE-ACTIVITY IN A SMALL UNPOLLUTED STREAM DURING THE MAIN VEGETA-TIVE PERIOD,
Gesamthochschule Essen (Germany, F.R.). Fach-

bereich 9 - Geologie.
For primary bibliographic entry see Field 5B.
W88-08163

BENZENE IN THE ANOXIC HYPOLIMNION OF A FRESHWATER LAKE, Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie. For primary bibliographic entry see Field 5B. W88-08174

DOWNCORE SULPHUR ISOTOPE RATIOS AND DIATOM INFERRED PH IN AN ARTIFI-CIALLY ACIDIFIED CANADIAN SHIELD

Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences. For primary bibliographic entry see Field 5C. W88-08200

SUCCESSFUL CONTROL OF THE FLOATING WEED SALVINIA MOLESTA IN PAPUA, NEW GUINEA: A USEFUL BIOLOGICAL INVASION NEUTRALIZES A DISASTROUS ONE,

United Nations Development Programme, Wewak (Papua New Guinea). Salvinia Control Project. For primary bibliographic entry see Field 4A. W88-08215

FORESEEABLE FLOODING AND DEATH OF COASTAL WETLAND FORESTS, Louisians State Univ., Baton Rouge. Lab. for Weland Soils and Sediments. For primary bibliographic entry see Field 2L. W88-08218

CONSERVATION AND UTILIZATION OF AQUATIC MACROPHYTES IN LAKE KAINJI, NIGERIA,

Kainji Lake Research Inst., New Bussa (Nigeria). E. A. Obot, and J. S. O. Ayeni. Environmental Conservation EVCNA4, Vol. 14, No. 2, p 168-170, Summer 1987. 3 fig, 4 ref.

Descriptors: *Aquatic weed control, *Lakes, *Artificial lakes, *Aquatic plants, *Macrophytes, *Aquatic weeds, *Water conservation, *Wildlife conservation, Livestock, Fodder, Fertilizers, Savannas, Semiarid lands, Hippopotamus, Manatee.

The explosive growth of aquatic macrophytes during the early years of man-made lakes has been linked to the high level of nutrients in the water, originating from decaying flooded organic materials. Although this explosive growth of floating macrophytes has not been realized in Lake Kainji, owing probably to the extensive clearing and burn ing operations that were carried out prior to im

poundment, the emergent grass Echinochloa stag-nina, in association with the floating grasses Vossia cuspidata and Sacciolepis africana, and the broad-leafed Polygonum senegalense, constitute a distinc-tive flora. The presence of the macrophytes has been attended by the return of the hippopotamus, and conservationists are optimistic for the reintroand conservationsis are optimistic for the reintro-duction of the manate as a result of the presence of the food macrophytes. The macrophytic vegeta-tion is also indicated as a valuable spawning-ground for economically important fish as well as game birds, and a useful source of dry season livestock fooder. The Kaipii Lake Research Institlivestock fodder. The Kainji Lake Research Institute has developed an aquatic weed utilization
system. Under this system, the harvested weeds are
dried in a solar drier, following which the dried
plants are fed to livestock. Livestock droppings are
used as fish-pond fertilizer and organic fertilizer on
vegetable farms. In an experimental feeding trial,
bulls gained approximately 2 kg (live-weight) per
week throughout the dry season. This ability to
maintain the weight of livestock using otherwise
useless aquatic weeds is a stimulating prospect
towards the improvement of livestock productivity
in the sayanna zone and other semi-arid regions. livestock fodder. The Kainji Lake Research Instiin the savanna zone and other semi-arid regions.
(Sand-PTT) W88-08220

DEVELOPMENT AND BIOLOGICAL STATUS OF LAKE KARIBA - A MAN-MADE TROPICAL

Moi Univ., Eldoret (Kenya). For primary bibliographic entry see Field 6G. W88-08231

NEW PURPLE SULFUR BACTERIUM FROM STRATIFIED FRESHWATER LAKES, AMOE-BOBACTER PURPUREUS SP. NOV.,

Konstanz Univ. (Germany, F.R.). Fakultaet fuer

B. Eichler, and N. Pfennig. Archives of Microbiology AMICCU, Vol. 149, No. 5, p 395-400, March 1988. 4 fig. 2 tab, 23 ref.

Descriptors: *Sulfur bacteria, *Lakes, *Limnology, *Stratified freshwater lakes, *Stratification, *Microbiological studies, *Bacteria, Freshwater lakes, Germany, Gas vacuoles, Okenone, Bacteriochlorophyll a, Chlorophyll a, Chromatiaceae.

Six strains of a new purple sulfur bacterium were isolated from the chemocline of four different freshwater lakes. Single cells were spherical to oval, nomotile and contained gas vacuoles in the central part of the cytoplasm. All strains contained abacteriochlorophyll a and okenone as the major carotenoid. The intercytoplasmic membrane system was of vesicular type. All strains resembled each other in growth conditions and use of simple organic carbon sources. The strains were able to grow microaerophilic in the dark, used hydrogen grow microaerophilic in the dark, used hydrogen sulfide, elemental sulfide or thiosulfate as electron donor, and lacked assimilatory sulfate reduction. On the basis of all characteristics, the new bacterium represents a new species of the genus Amoebo-bacter, A. purpureus sp. nov. (Author's abstract)

CHRYSOPHYCEAN MICROFOSSILS PRO-VIDE NEW INSIGHT INTO THE RECENT HIS-TORY OF A NATURALLY ACIDIC LAKE (CONE POND, NEW HAMPSHIRE),

Queen's Univ., Kingston (Ontario). Dept. of Biol-

For primary bibliographic entry see Field 5C. W88-08258

PROCESSES AND CAUSES OF LAKE ACIDIFI-CATION DURING SPRING SNOWMELT IN THE WEST-CENTRAL ADIRONDACK MOUN-TAINS, NEW YORK,

Virginia Univ., Charlottesville. Dept. of Environmental Science

For primary bibliographic entry see Field 5C. W88-08259

Lakes-Group 2H

EFFECTS OF IRRADIANCE ON THE COMMUNITY STRUCTURE AND BIOMASS OF ALGAL ASSEMBLAGES IN LABORATORY STREAMS, Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology.

A. D. Steinman, and C. D. McIntire.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 9, p 1640-1648, September 1987. 18 fig., 33 ref. National Science Foundation Grant BSR-8318386.

Descriptors: *Irradiance effects, *Irradiation, *Biomass, *Taxonomy, *Stream biota, *Light intensity, *Aquatic populations, *Plant populations, *Stream algae, *Laboratory streams, USA, Algal populations, Taxonomic structure, Physiognomy, Diatoms, Algae, Benthic flora.

Studies in natural streams have implicated irradiance as a factor which has a strong influence on the dynamics of algal communities. In this study, laboratory streams were used in a replicated, experimental design to investigate whether differences in algal blooms, taxonomic structure and physiognomy result from exposure to different irradiances. Effects of four photon flux densities (15, 0, 150 and 400 microE per square meter per second) on locally collected benthic stream algae were monitored over a 48 day period. Biomass were monitored over a 48 day period. Biomass increased in all streams during the experiment, but the streams exposed to the highest irradiance had 25 times more biomass at the end of the experiment 25 times more biomass at the end of the experiment than the channels exposed to the lowest irradiance. Although diatoms were the dominant algal class in all streams, the relative abundance of chlorophytes was much greater in streams exposed to 150 and 400 microE per square meter per second than in channels treated with 15 and 50 microE per square meter per second. Detrended correspondence analysis indicated that the successional trajectories of assemblages exposed to low irradiances were quite distinct from those of assemblages treated with high irradiances. Observations of assemblage physicanomy by scanning electron microscopy rehigh irradiances. Observations of assemblage physiognomy by scanning electron microscopy revealed that at low irradiances, a densely packed understory of adnate diatoms, with a few overstory diatoms, covered the tile surface. At high irradiances, tiles were overlaid with thick algal mats composed of filamentous and coenobic chlorophytes and diatoms of various growth forms (rosette, chain-forming and solitary). The experimental results suggested that differences in biomass and community structure among the laboratory assemblages were a direct result of light energy and that irradiance is a major factor influencing algal dynamics in lotic ecosystems. (Author's abstract) W88-08260

DURABLE AND TRANSPORTABLE LIMNE-TIC ENCLOSURE SYSTEM SUITABLE FOR WIND-EXPOSED LAKES,

Limnologisch Inst., Oosterzee (Netherlands). Tjeu-kemeer Lab.

nary bibliographic entry see Field 7B.

CONTRIBUTION OF CALCITE TO THE PARTICLE-SIZE SPECTRUM OF LAKE MICHIGAN SESTON AND ITS INTERACTIONS WITH THE PLANKTON,

National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lah.

Research Lab.
H. A. Vanderploeg, B. J. Eadie, J. R. Liebig, S. J.
Tarapchak, and R. M. Glover.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 11, p 1898-1914,
November 1987. 14 fig, 5 tab, 65 ref.

Descriptors: *Chemical precipitation, *Suspended solids, *Seston, *Limnology, *Lake Michigan, *Calcite, *Plankton, *Particle size spectrum, *Calcite precipitation, *Lakes, Coulter counter method, Whitings, Cladocerans, Lake chemistry, Food web, Chemical properties.

We determined the contribution of calcite to the total particle-size spectrum of Lake Michigan seston during different seasons in 1978-83 and 1985, employing a novel Coulter counter method to examine the intensity and ecological effects of calcite

whitings that result from autogenic precipitation of whitings that result from autogenic precipitation of calcite. The whitings were most intense during September when 12-56% of the total particle volume was calcite. Overall, the food web dynamics were more controlling than controlled by whitings. Year-to-year variation in calcite concentration was probably caused by predation-controlled variation in primary production which drives calcite precipitation through CO2 uptake. Feeding rate of cladocerans in Lake Michigan is slightly reduced (16%) by calcite, but that of copepods is not. Light extinction is only slightly increased. reduced (10%) by calcite, but that of copepods is not. Light extinction is only slightly increased. Coprecipitation and sinking of P with calcite is probably a minor factor in regulating P concentration in the epilimnion of Lake Michigan. Removal of nutrients is enhanced by increased sinking rates caused by inclusion of calcite in fecal pellets and matter. Although all of the effects of calcite on plankton dynamics appear to be subtle in Lake plankton dynamics appear to be subtle in Lake Michigan, large effects can be expected for lakes of greater calcium hardness and eutrophy. (Author's abstract)

OVERVIEW OF STUDIES ON THE NUTRIENT STATUS OF LAKE ONTARIO, National Water Research Inst., Burlington (Ontar-

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2042-2046, December 1987. 2 fig, 19 ref.

Descriptors: *Limnology, *Lakes, *Limiting nutrients, *Phosphorus removal, *Stratification, *Nutrients, *Food web, *Lake Ontario, Bioconcentration, Nutrient availability, Phosphates, Nitrogen, Nitrates, Plankton, Zooplankton, Algal growth, Upwelling, Seasonal variation.

A multidisciplinary seasonal study of nutrient dy-namics in Lake Ontario included extensive investinamics in Lake Ontario included extensive investigations of physical processes but focused particularly on the influence of phosphorus and nitrogen
on algal growth and plankton composition and also
on the transport rates between biological compartments. Spring soluble reactive phosphate (SRP)
has dropped by 70% and spring total P (TP) has
decreased 50% from that in the early 1970's. No
reduction in summer TP or chlorophyll a has been
observed. Spring nitrate concentrations have increased from 1968 to 1982. The relationship between chlorophyll a and nitrate and P indicates
that Lake Ontario has probably shifted from N
limitation to P limitation. P loading in Lake Ontario
to continues throughout the year in contrast to
most lakes where P loading usually occurs with
the spring freshet. Plankton at the nearshore stations become P deficient in April whereas plankton tions become P deficient in April whereas plankton from the midlake areas do not become P deficient until stratification. Summer upwelling reduces the degree of P deficiency. During the summer, P is recycled through community excretion processes and sedimentation losses are low. Prior to the summer stratification, sedimentation of the diatom community is the principal pathway for P and C losses. (Miller-PTT)

STRATIFICATION, CURRENTS, AND UP-WELLING IN LAKE ONTARIO, SUMMER

National Water Research Inst., Burlington (Ontar-

National water Research inst., Burlington (Ontario). Aquatic Physics and Systems Div.

T. J. Simons, and W. M. Schertzer.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2047-2058, December 1987. 9 fig, 8 ref.

Descriptors: *Limnology, *Stratification, *Lake Ontario, *Circulation, *Upwelling, *Water cur-rents, *Wind, Seasonal variation, Temperature variation, Physical properties.

Physical measurements were carried out on Lake Ontario during the summer of 1982. Seasonal variation of stratification and circulation are illustrated by monthly averages of temperature and current distributions in a north-south cross section of the lake. Day-to-day variations of temperature and currents are presented for three periods coinciding with biochemical investigations along the same transect of the lake. A wind-induced upwelling event followed by alongshore propagation of a warmwater wave is described. Wave propagation along the shore is explained on the basis of a Kelvin-wave mechanism. Updwelling at a given location depends not only on local wind forcing but also on the history of wind-induced upwelling at other points around the lake. (Miller-PTT) W88-08270

RESPONSE OF LAKE ONTARIO TO REDUC-TIONS IN PHOSPHORUS LOAD, 1967-82,

Inland Waters Directorate, Burlington (Ontario). Water Quality Branch. R. J. J. Stevens, and M. A. Neilson.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2059-2068, December 1987. 7 fig, 1 tab, 56 ref.

Descriptors: *Phosphorus removal, *Limnology, *Total phosphorus, *Nitrogen cycle, *Lake Ontario, *Lakes, *Epilimnion, Ecosystems, Soluble reactive phosphorus, Regression analysis, Nitrites, Nitrogen, Stratification, Algal biomass.

Total phosphorus (TP) loading to Lake Onfario has declined from 14600 1/yr-in 1982. Midlake spring TP has supported rapidly to these reductions, decreasing at the rate of 1.09 micrograms/lyr from a maximum of 30.6 micrograms/l in 1972 to 12.8 micrograms/l in 1982. Spring soluble reactive phosphorus (SRP) exhibited a proportionally larger decrease than TP so that 1982 SRP was 33% of 1973 levels compared with 42% for TP. A multiple regression equation indicated an 80% response time of spring TP within 2 yr and a 90% response time of spring TP within 2 yr and a 90% response time of spring TP within 2 trate of 9.5/micrograms/l yr causing N:P ratios to increase from 10 to 32. Mean summer epilimentic TP declined at the rate of only 0.3 micrograms/l/ increase from 10 to 32. Mean summer epilimnetic TP declined at the rate of only 0.3 micrograms/l/yr from 1977 to 1982 so that mean summer TP levels now exceed earlier TP has been summer TP. yr from 1971 to 1982 so that mean summer 1P levels now exceed spring TP by 1-2 micrograms/l. This suggests that loading to the lake during the stratified period has not shown a similar decline and may be responsible for the lack of a trend in algal biomass indicators during this period. (Author's abtract) thor's abstract)

PHOSPHORUS DEFICIENCY OF LAKE ON-TARIO PLANKTON,

National Water Research Inst., Burlington (Ontar-

D. R. S. Lean, A. A. Abbott, and F. R. Pick. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2069-2076, December 1987. 6 fig. 2 tab, 19 ref.

Descriptors: *Limnology, *Phosphate Deficiency Index, *Phosphorus, *Plankton, *Lake Ontario, *Thermal stratification, *Lakes, Ecosystems, Carbon assimilation, Turnover time, Alkaline phosphatase activity, Photosynthesis, Photosynthetic depression, Protein to carbohydrate ratio, Nutrients, Algae, Enzymes.

The phosphate deficiency index (PDI), the ratio of photosynthetic carbon assimilation at optimal light to the maximum uptake velocity for phosphate, showed that P deficiency occurred in the near-shore plankton of Lake Ontario during the spring thermal bar conditions and in the midlake plankton immediately after stratification. This condition persisted until October, when deep mixing of the water column occurred. Carbon and phosphate assimilation were by similar size classes, and as the water column occurred. Carbon and phosphate assimilation were by similar size classes, and as the ratio of two rate processes, PDI was independent of both temperature and biomass. Turnover time and alkaline phosphates activity (APA) correlated with PDI. Short-term photosynthetic depression with phosphate enrichment occurred in only 7 of 23 experiments and may either reflect P-sufficient conditions or high protein to carbohydrate ratios due to physical events common to large lakes. PDI, protein to carbohydrate ratios, and photosynthetic depression respond principally to algal active. Although turnover time and APA reflect the ity. Although turnover time and APA reflect the activity of smaller microorganisms, primarily he-

Group 2H—Lakes

terotrophic bacteria, all indices were consistent. (Author's abstract) W88-08272

SUBCELLULAR PHOSPHORUS KINETICS FOR LAKE ONTARIO PLANKTON,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
D. R. S. Lean, and R. L. Cuhel.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2077-2086, December 1987. 9 fig. 5 tab, 22 ref.

Descriptors: *Phosphorus, *Kinetics, *Lake Ontario, *Plankton, *Limnology, *Lakes, Microbiological studies, RNA, DNA, HTCA, Isotopes, Radioactive isotopes, Seasonal depletion

bcellular distribution of recently incorporat-The subcellular distribution of recently incorporated 32PO4 was used to demonstrate that plankton in the surface waters of Lake Ontario were phosphorus deficient to some extent throughout the entire study period from April to October 1982. Most (approximately, 80%) of the initial uptake of carrier-free radioactive PO4 was the low molecular weight (LMW) fraction. Ribonucleic acid (RNA) was fixe other major fraction. Although uptake was often complete within 1 hr, changes in the subcellular distribution continued for 6-20 hr with about half the LMW 3.7° being transferred to RNA. Both a phospholipid fraction and a fraction extracted with hot trichloroacectic acid (HTCA) containing DNA and high molecular weight polyphostaining DNA and high molecular weight polyphosphate increased to 4-15% of the total isotope incorporated. In contrast with these experiments where net P uptake was zero with added PO4 the net influx continued for periods in excess of 30 hr but the subcellular distribution was constant within 2-4 hr. About 80% of the initial uptake was as LMW 32P and a rapid net synthesis of LMW polyphosphate was observed. These patterns were common for both small and large plankton classes. (Author's

INTERPRETATIONS OF ALKALINE PHOS-PHATASE ACTIVITY IN LAKE ONTARIO, Ottawa Univ. (Ontario). Dept. of Biology

F. R. Pick. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2087-2094, December 1987. 5 fig, 4 tab, 41 ref.

Descriptors: *Limnology, *Alkaline phosphatase activity, *Lake Ontario, *Plankton, Biomass, Phosphorus deficiency, Thermal stratification, Enzymes, Algae, Ecosystems

Alkaline phosphatase activity (APA) in Lake On-tario reached maximum levels of 0.25 microMP released/hr during 1982. Relatively high values were first detected in nearshore surface water in May concurrent with thermal bar development and at a later date (end of June) at a midlake station following transport of nearshore water to the middle. APA remained detectable throughout the summer but declined in mid-August as a result of upwelling events. With fall mixing, APA per-sisted throughout the entire water column. Addi-tions of phosphate did not inhibit APA until en-richments were much greater than maximum ambi-ent concentrations of soluble reactive P. The find-ings suggest that APA is not a sensitive indicator. ent concentrations of solution reactive P. I ne find-ings suggest that APA is not a sensitive indicator of P deficiency. APA activity was correlated with nanop'ankton (2-20 micrometers) plus picoplank-ton (0.2-2 micrometers) biomass but not with total algal biomass. APA associated with particles > 12 micrometers was relatively unimportant. (Author's abstract) W88-08274

CARBOHYDRATE AND PROTEIN CONTENT OF LAKE SESTON IN RELATION TO PLANK-TON NUTRIENT DEFICIENCY

Ottawa Univ. (Ontario). Dept. of Biology.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2095-2101, December 1987. 6 fig, 2 tab, 27 ref.

Descriptors: *Limnology, *Carbohydrates, *Proteins, *Lake Ontario, *Nutrients, *Lakes, *Plankton, *Seston, Ecosystem, Biomass, Protein to carbohydrate ratio, Stratification, Diurnal changes, Jacks Lake, Chlorophyll a.

Carbohydrate and protein content of seston from Lake Ontario and Jacks Lake were measured during the ice-free season as a means of estimating plankton nutritional status. Despite the similar plankton nutritional status. Despite the similar trophic level of these lakes, protein to carbohy-drate ratios were generally above 1 in Lake Ontar-tio indicating lack of severe phosphorus or nitrogen deficiency. On the other hand, those of Jacks Lake were always below 1 indicating severe nutrient stress. However, in Lake Ontario, some discrepanstress. However, in Lake Ontario, some discrepancies with other indicators of nutrient status occurred which complicate interpretations of the ratio. The ratio will also not distinguish phosphorus from nitrogen deficiency. On average, 28% (11-80%) of the particulate organic carbon is carbohydrate carbon and 80% (40-100%) of the particulate organic nitrogen is protein-nitrogen in Lake Ontario. Chlorophyll a explained 44% of the variation in carbohydrate but only 22% of the variation in carbohydrate but only 29% of the variation in protein. Diurnal as well as seasonal and vertical changes in the ratio of protein to carbohydrate were observed. (Author's abstract) W88-08275

PROTEIN SYNTHESIS BY LAKE PLANKTON MEASURED USING IN SITU CARBON DIOX-IDE AND SULFATE ASSIMILATION, Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Biology and Living

R. L. Cuhel, and D. R. S. Lean. R. L. Cunel, and D. R. S. Lean. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2102-2117, December 1987. 11 fig. 6 tab, 47 ref. NSF Grants OCE80-18444 and OCE82-19125.

Descriptors: *Limnology, *Carbon dioxide, *Sulfates, *Plankton, *Lakes, *Lake chemistry, Ecosystems, Nutrients, In situ tests, Chlorophyll a, Photosynthesis, Algae, Proteins, Phytoplankton. synthesis, Algae, Proteins, Phytopla

Sequential 4-6 hr in situ measurements of carbon dioxide and sulfate uptake showed midday deepening of the depth of P sub max and photoinhibition of upper water column samples. Analysis of subcellular fractions accentuated total uptake measurements with net protein synthesis providing a direct ments with net protein synthesis providing a direct measure of growth. The percentage of carbon assimilated into protein was smallest at the depth of maximum photosynthesis and increased with light limitation. Summed incubations agreed well with all-day deployments for total carbon fixation and protein synthesis. Assimilation numbers were consistently low: <2.5 gcgChlorophyll a/h with integrated (0-20 m) areal production of 616-1467 mg C/m sq and 7.5-32.4 mg S/sq m during the light day. Nonreductive sulfate assimilation (predominantly ester SO4(-) accounted for up to 40% of the total sulfate uptake when diatoms predominated. Protein synthesis measured with 355 (200-1000 mg protein/sq m during the light day) increased 57-39% overnight. Hourly rates were similar during light and scotophase incubations. Night metabolism substantially alfered the biochemical composition (e.g. protein, ligit) and carbohydrate) of the nsm suostantially aftered the biochemical composi-tion (e.g. protein, lipid and carbohydrate) of the plankton with respect to newly incorporated carbon. Combined plant-specific H14CO3(-) and general microbial 35SO4 (--) techniques suggested algal dominance in the mixed water. (Author's abstract) abstract) W88-08276

INFLUENCE OF LIGHT INTENSITY, LIGHT QUALITY, TEMPERATURE, AND DAY-LENGTH ON UPTAKE AND ASSIMILATION OF CARBON DIOXIDE AND SULFATE BY

LAKE PLANKTON,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Biology and Living

Resources. R. L. Cuhel, and D. R. S. Lean. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2118-2132, December 1987. 13 fig. 5 tab, 39 ref. NSF Grants OCE80-18444 and OCE82-19125.

Descriptors: *Light intensity, *Light quality, *Limnology, *Temperature effects, *Carbon dioxide, *Sulfates, *Lake Ontario, *Lake chemistry, Lakes, *Plankton, Ecosystems, Phytoplankton, Photosynthesis, Carbohydrates, Proteins, Biomass.

The biochemical composition of newly produced phytoplankton biomass in Lake Ontario varied systematically with respect to experimentally manipulated incident light intensity and environmentally imposed water temperature and daylength, but was insensitive to light quality. Total uptake of 14C-babeled bicarbonate was light dependent while 35SO4 (--) uptake was light stimulated. Subcellular allocation of 14C for relative protein, carbohydrate and lipid polymer synthesis responded sensitively to subsaturating light. Pathways of 35S assimilation were unaffected by light intensity. Night protein synthesis and attendant respiration of polymeric carbohydrates was a function of prior light history; with daytime illumination at P sub opt, day and night rates of 35SO4-Si incorporation into protein were often indistinguishable. Using April-November data from P sub opt only, allocation of carbon to carbohydrate polymer storage for night growth to carbohydrate polymer storage for night growth was strictly proportional to night length. The pro-portion of carbon contained in protein was strong-ly correlated with in situ water temperature. The lack of cross-correlation suggests that temperature and daylength exert independent constraints on the biochemical composition of lake microplankton. (Author's abstract) W88-08277

NITROGEN TRANSFORMATIONS IN LAKE ONTARIO.

National Water Research Inst., Burlington (Ontar-

D. R. S. Lean, and R. Knowles. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2133-2143, December 1987. 12 fig, 4 tab, 46 ref.

Descriptors: *Lake Ontario, *Ammonium, *Lakes, Ecosystems, *Lake chemistry, *Nitrogen cycle, *Nitrates, Nitrites, Stratification, Nitrous oxide, Food chain, Denitrification, Sedimentation, Sea

Concentrations of ammonium plus nitrite in Lake Ontario were highly correlated with ammonium regeneration from zooplankton excretion (r+0.966), inferring that elevated nitrite concentrations result from nitrification. Nitapyrin-sensitive dark 14C-labeled bicarbonate assays confirmed high rates of nitrification by chemoautotrophic bacteria. 15N-labeled experiments showed that nitrite, not ammonium, was the principal form of N used for total microbial protein synthesis. Size fractionation experiments also suggested that small cells were responsible for most of the ammonium uptake, while large cells used mostly nitrate. Nitrate depletion in the surface waters during trate depletion in the surface waters during summer stratification resulted from movement to summer stratification resulted from movement to particulate N, nitrite, ammonium as well as losses in particulate N due to sedimentation. At least one third, however, was unaccounted for and may have been converted to protein which would move up the food chain to larger organisms (fish) not sampled during conventional water chemistry. Nitrous oxide profiles showed that nitrate losses through denitrification are unlikely to occur. Consequently, unless nitrate loading to Lake Ontario is reduced, nitrate concentrations should be expected to continue to increase. (Author's abstract) W88-08278

PHOTOINHIBITION OF DCMU-ENHANCED FLUORESCENCE IN LAKE ONTARIO PHYTOPLANKTON,

California Univ., Santa Barbara. Dept. of Biologi-

cal Sciences.

M. Putt, G. P. Harris, and R. L. Cuhel.

Canadian Journal of Fisheries and Aquatic Sciences CIFSDX. Vol. 44, No. 12, p 2144-2154,

December 1987. 9 fig, 1 tab, 47 ref. NSF Grant

Descriptors: *Limnology, *Fluorescence. *Photoinhibition, *Lake Ontario, *Phytoplankton,

*Lakes, *Photosynthesis, Ecosystems, Bioassays, Vertical distribution, Seasonal variation.

Measurement of 1-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU) suggested that photoinhibition of photosynthesis was frequently an artifact of in situ bottle incubations in Lake Ontario phytoplankton. In a seasonal study, F sub DCMU of all populations was depressed by bright light in an incubator. However, when the euphotic zone did not exceed the depth of the mixed layer, vertical transport of phytoplankton into either low-light or dark regions apparently allowed reversal of photoinhibition of F sub DCMU. Advantages of F sub DCMU as a bioassay of vertical mixing include rapidity of response time, ease of measurement on the field, and insensitivity of this parameter to changes in phossponse time, ease of measurement on the field, and insensitivity of this parameter to changes in phosphorous status of the population. Because of seasonal changes in the photoadaptive response of natural populations, the rate constants and threshold light levels required to cause the response must be determined at each use if the method is to be quantitative. (Author's abstract)

DIFFERENCES BETWEEN NEARSHORE AND OFFSHORE PHYTOPLANKTON COMMUNI-TIES IN LAKE ONTARIO, National Water Research Inst., Burlington (Ontar-

io). I. M. Gray. Canadian 1. M. Oray.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2155-2163, December 1987. 4 fig, 4 tab, 43 ref.

Descriptors: *Lake restoration, *Lake Ontario, *Lakes, *Water quality, *Phytoplankton, *Biomass, Chlorophyll a, Algae, Seasonal variation, Spatial variation.

Differences between nearshore and offshore phytoplankton biomass and composition were evident in Lake Ontario in 1982. Phytoplankton biomass was characterized by multiple peaks which ranged over three orders of magnitude. Perhaps as a consequence of the three times higher current velocities at the northshore station, phytoplankton biomass ranged from 0.09 to 9.00g/cu m compared with 0.10 to 2.40 g/cu m for the midlake station. Bacillariophycae was the dominant group at the northshore station until September when Cyanophyta contributed most to the biomass (83%). Although Bacillariophycae was the principal component of contributed most to the biomass (83%). Although Bacillariophycae was the principal component of the spring phytoplankton community at the midlake station, phytoflagellates (49%) and Chlorophycae (25%) were responsible for summer biomass, with the Chlorophycae expanding to 80% in the fall. The seasonal pattern of epilimnetic chlorophyll a correlated with temperature. While chlorostatil a correlated with temperature. While chlorophyll a concentrations were similar to values from 1970 and 1972, algal biomass had declined and a number of eutrophic species previously found were absent in 1982. (Author's abstract) W88-08280

PICOPLANKTON AND NANOPLANKTON BIOMASS IN LAKE ONTARIO: RELATIVE CONTRIBUTION OF PHOTOTROPHIC AND HETEROTROPHIC COMMUNITIES,

Ottawa Univ. (Ontario). Dept. of Biology. F. R. Pick, and D. A. Caron. Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 44, No. 12, p 2164-2172, December 1987. 9 fig. 46 ref.

Descriptors: *Limnology, *Lake Ontario, *Plankton, *Lakes, *Biomass, *Epifluorescence microscopy, Phototrophic bacteria, Heterotrophic bacteria, Sessonal variation

The seasonal and vertical abundance of phototrophic and heterotrophic nanoplankton (2-20 micrometers) and picoplankton (0-2-2 micrometers) was estimated in Lake Ontario during 1982 by epifluorescence microscopy. Phototrophic and heterotrophic nanoplankton abundance differed by less than an order of magnitude and was typically present at densities of 1,000 cells/ml. Heterotrophic nanoplankton was only half as abundant as phototrophic nanoplankton, but on several dates

was more abundant. Both populations peaked in late June to early July. Phototrophic picoplankton, primarily chroococoid cyanobacteria increased rapidly during midsummer, reaching a maximum epilimnetic concentration of 400,000 cells/ml in late August. Heterotrophic picoplankton (bacteria) showed a similar seasonal pattern, reaching a maximum abundance in September (6,000,000 cells/ml). The concentration of both picoplankton populations was significantly correlated with temperature. By late summer, picoplankton biomass represented 74% and pico-cyanobacteria alone 50% of the total weight biomass of microorganisms < 20 micrometers; these populations are generally crometers; these populations are generally issed by inverted microscope techniques. (Author's abstract) W88-08281

CHARACTERIZATION OF CYANOBACTER-IAL PICOPLANKTON IN LAKE ONTARIO BY TRANSMISSION ELECTRON MICROSCOPY, National Water Research Inst., Burlington (Ontar-

National Water Research inst., Burlington (Ontario). Aquatic Ecology Div.
G. G. Leppard, D. Urciuoli, and F. R. Pick.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2173-2177,
December 1987. 5 fig. 1 tab, 14 ref.

Descriptors: *Limnology, *Lake Ontario, *Plankton, *Epifluorescence microscopy, *Transmission electron microscopy, *Lake ecosystems, *Aquatic ecosystems, *Cyanobacteria, Picoplankton, Microbiological studies.

Many chroococcoid cyanobacteria from Lake Ontario, characterized by epifluorescence in concert with transmission electron microscopy, had a Type I ultrastructure which is the major type in oceanic waters. Such cells had a multilayered cell envelope and their polyhedral bodies were interspersed with the central nuclear material. All thylakoids were peripheral and were arranged concentrically, with no intrusion into the nuclear region. Related chroococcoid types were also seen but these were much less abundant. The most numerous cell type in all water samples was a small, Gram-negative, rodlike bacterium. Many of these rods were sufficiently small to pass a filter of 0.45 micrometers pore size but nine had a diameter less than 0.2 micrometers. Attempts to isolate and describe the cyanobacterial picoplankton presented some unsual difficulties having a potential to mislead limnological analyses. These are described, and to some extent they are resolved here. (Author's abstract) Many chroococcoid cyanobacteria from Lake Onstract) W88-08282

ZOOPLANKTON SEASONAL SUCCESSION IN LAKE ONTARIO AT NORTHSHORE, MID-LAKE, AND SOUTHSHORE STATIONS IN 1982, AND A COMPARISON WITH 1970, Waterloo Univ. (Ontario). Dept. of Biology. W. D. Taylor, H. J. Fricker, and D. R. S. Lean. Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 44, No. 12, p 2178-2184, December 1987. 5 fig. 1 tab, 41 ref.

Descriptors: *Lake Ontario, *Lakes, *Limnology, *Plankton, *Zooplankton, Biomass, Seasonal variation, Stratification, Species composition, Predation, Salmon, Nutrients.

The seasonal pattern of zooplankton succession in Lake Ontario was similar at three stations along a north-south transect, with differences attributable to physical factors. Because of warming within the thermal bar zone, the spring succession at the northshore station was early relative to the mid-lake station, but after stratification the north station lake station, but after stratification the north station lagged behind due to frequent upwelling events. Thermal bar formation along the south was followed by downwelling throughout the summer, giving a deeper epilimnion. These events may have contributed to not only the greater biomass at this location, but also succession which preceded that at the other stations during summer and fall. The species composition and the timing of the summer succession were very similar to those reported for 1970. Lake Ontario zooplankton did not change markedly in response to changes in nutrient loading and salmonid predators during the 1970s. (Author's abstract) thor's abstract)

W88-08283

SEASONAL AND VERTICAL DISTRIBUTION OF CILIOPHORA IN LAKE ONTARIO, Waterloo Univ. (Ontario). Dept. of Biology

W. D. Taylor, and M. L. Heynen.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2185-2191, December 1987. 2 fig, 4 tab, 31 ref.

Descriptors: *Limnology, *Lake Ontario, *Vertical Distribution, *Seasonal distribution, *Lakes, a Distribution, *Seasonal distribution, *Lakes, *Pepilimnion, *Pupulimnion, *Protozoa, Microbiological studies, Biomass, Stratification, Food chains, Grazing, Plankton.

Ciliated protozoa were sampled at discrete depths from April through October 1982 at a nearshore (38 m depth) and an offshore (178 m depth) station in Lake Ontario. Nearshore, ciliates increased from in Lake Ontario. Nearshore, ciliates increased from < 1 g/sq m in early spring to maximum of about 5 g/sq m (wet weight) within the thermal bar in late May and early June. Summer values varied around 2 g/sq m and declined even further in October. Offshore ciliate biomass was relatively constant; the observed range was only 2.8-6.5 g/sq m. Early spring biomass was much higher than meanhore, suggesting a significant population per ist through the winter, but the spring biomass increase was later. Although biomass concentration was greater in the epilimnion, on an areal basis most of the later. Although biomass concentration was greater in the epilimnion, on an areal basis most of the population resided in the hypolimnion. The hypolimnetic population declined during the summer period of thermal stratification. The observed number of taxa ranged from 15 to 30/sample. Most had distinct seasonal and vertical distribution. The majority appear to be algivores, but the role of cliates in the food web of Lake Ontario remains largely unknown. Their biomass is comparable with that of metazoan zooplankton, and with their higher metabolic rates, they probably perform much more of the total grazing. (Author's abstract) W88-08284 W88-08284

SPATIAL HETEROGENEITY OF NUTRIENTS AND ORGANIC MATTER IN LAKE ONTARIO, Inland Waters Directorate, Burlington (Ontario). Water Quality Branch.

For primary bibliographic entry see Field 5C. W88-08285

PHOPSHATE ION INTERACTIONS AT THE SEDIMENT-WATER INTERFACE IN LAKE ONTARIO: RELATIONSHIP TO SEDIMENT ADSORPTION CAPACITIES,

National Water Research Inst., Burlington (Ontar-

For primary bibliographic entry see Field 5B. W88-08286

REDUCTION OF CLADOPHORA BIOMASS AND TISSUE PHOSPHORUS IN LAKE ON-TARIO, 1972-83.

National Water Research Inst., Burlington (Ontar-io). Aquatic Ecology Div. For primary bibliographic entry see Field 5G. W88-08287

DIFFERENTIAL THERMAL AND THERMO-GRAVIMETRIC ANALYSIS OF SEDIMENT-FORMING MATERIALS FROM LAKE ONTAR-

National Water Research Inst., Burlington (Ontar-io). Aquatic Ecology Div. G. M. Zimmermann, D. R. S. Lean, and M. N.

Charlton. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2216-2224, December 1987. 10 fig, 2 tab, 27 ref.

Descriptors: *Limnology, *Differential thermal analysis, *Thermogravimetric analysis, *Lake On-tario, *Sedimentation, *Lake chemistry, Carbohy-drates, Calcium carbonate, Oxidation, Seston, Sedi-ments, Organic matter, Chlorella.

Group 2H-Lakes

Differential thermal analyses (DTA) and thermo-Differential thermal analyses (DTA) and thermogravimetric analyses (TGA) of seston, sediments, and sediment trap material from Lake Ontario were generally similar to each other but were strikingly different from those of the green alga Chlorella pyrenoidosa. Coinciding with the principal weight loss of carbohydrate material, the main exothermic reaction for all lake samples began at 200-250 C and peaked at 345-355 C. Trap samples weight over the sesson and samples from the deep varied over the season and samples from the deep traps (178 m) had exotherms which were broader traps (176 m) had extinct in which were oroader with less energy content than from traps near the bottom of the metalimnion. This trend continued into the sediments. Compounds likely to be found in sediments (cellulose, chitin, and humic subin sediments (cellulose, chilin, and nume sub-stances) were also analyzed. The calcium carbon-ate endotherm which begins near 675 C centigrade distinguishes this compound from the total 'ash' content. DTA and TGA can be used to detect changes in composition of lake organic matter during the sediment forming process. (Author's W88-08288

TIME OF ONSET OF FULL THERMAL STRATIFICATION IN LAKE ONTARIO IN RELATION TO LAKE TEMPERATURE IN WINTER

National Water Research Inst., Burlington (Ontar-

National Water, Research Inst., Burlington (Ontario). Aquatic Ecology Div. G. K. Rodgers.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2225-2229, December 1987. 2 fig. 1 tab, 9 ref.

Descriptors: *Limnology, *Lake Ontario, *Thermal stratification, *Stratification, *Remote sensing, *Temperature gradient, Seasonal variation, Surveys, Water temperature, Water currents.

Using records from 1965 to 1985 including data from vessel surveys and remote sensing by aircraft and satellite, relationships were explored among winter severity, early spring water temperature, and the date on which thermal stratification is and the date on which internal straintanton is established throughout Lake Ontario. One extreme event stands out in 1983, in association with the anomalous extent of the El Nino current in the Pacific Ocean. Winter conditions in 1983 in Lake Ontario appear to be within the warmest 5% of winters on record: this is reflected in air and water temperatures and in the very early onset of full thermal stratification. The data provide a means of asserting the spring conditions of any particular year and also provide some predictive capability should one wish to schedule experiments to take advantage of particular thermal structures in spring or early sum W88-08289 ner. (Author's abstract)

LAKE ONTARIO LIFE SUPPORT SYSTEM, National Water Research Inst., Burlington (Ontar-

D. R. S. Lean, H. J. Fricker, M. N. Charlton, R. L.

D. R. S. Lean, H. J. Fricker, M. N. Charlton, R. L. Cubel, and F. R. Pick. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2230-2240, December 1987. 9 fig. 2 tab, 62 ref.

Descriptors: *Limnology, *Nutrients, *Food chains, *Primary productivity, *Lake Ontario, *Lakes, *Plankton, Zooplankton, Phosphorus, Calcium carbonate, Silica, Particulate carbon, Chlorophyll, Soluble reactive phosphate, Nitrite, Nitrate, Ammonium, Temperature effects, Photosynthesis, Grazing, Sedimentation, Bacteria, Mineralization.

Primary productivity provides most of the energy to support aquatic food chains. The rate is not only influenced by available solar radiation but also by temperature, availability of phosphorus, and the influence of physical mixing processes. The special features of Lake Ontario such as changes in phosphorus concentration, calcium carbonate precipitation and silica deficiency on primary productivity, concentration of particulate carbon, and chlorophyll are discussed. Lack of understanding of food chain and nutrient regeneration processes is illustration. chain and nutrient regeneration processes is illus-trated through failure to balance carbon production with losses through zooplankton grazing and sedimentation. It was demonstrated, that bacteria

are not responsible for nutrient regeneration through 'mineralization' but nutrients are effectively recycled in the water column at the second and third trophic levels. (Author's abstract)

ALTERATION OF CARBON CYCLING BY BEAVER: METHANE EVASION RATES FROM BOREAL FOREST STREAMS AND RIVERS,

BOREAL FOREST STREAMS AND RIVERS, University Coll. of North Wales, Bangor. School of Animal Biology. T. E. Ford, and R. J. Naiman. Canadian Journal of Zoology CJZOAG, Vol. 66, No. 22, p 529-533, February 1988. 2 fig, 4 tab, 20 ref. NSF Grant BSR-31-05677.

Descriptors: *Limnology, *Ecology, *Aquatic life, *Aquatic animals, *Carbon cycling, *Streams, *Rivers, *Ponds, *Beavers, Hydrology, Chemical properties, Methane, Boreal forest, Canada.

In boreal forest drainage networks, beaver (Castor canadensis) apparently influence the biogeochemi-cal cycling of carbon by creating conditions of sediment accumulation in streams, providing anoxic conditions suitable for significant methanogenesis. To test this assumption the author measured methane evasion rates in streams, ranging in size from first to sixth order, in the Matamek River drainage network, Quebec, Canada. Evasion rates varied between 0.04 and 4.41 g C (CH4) per square meter/yr. There was no correlation between stream size or water temperature and evasion rate. However, methane evasion was 33-fold greater in beaver ponds than at other sites, representing 3.6% of the measured annual carbon output. In contrast, methane evasion accounted for only 0.05-0.5% of the annual carbon output from sites not modified by beaver. (Author's abstract) W88-08303

FISHERIES IN MAN-MADE POOLS BELOW GRADE-CONTROL STRUCTURES AND IN
NATURALLY OCCURRING SCOUR HOLES
OF UNSTABLE STREAMS,
Agricultural Research Service, Oxford, MS. Sedi-

For primary bibliographic entry see Field 81. W88-08384

SPATIO-TEMPORAL DYNAMICS OF MACROINVERTEBRATE MOVEMENTS IN A LARGE RIVER (DYNAMIQUE SPATIO-TEMPORELLE DES DEPLACEMENTS DE MAPORELLE DES DEPLACEMENTS DE MAP CROINVERTEBRES DANS UNE GRANDE RI-

VIERE), Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces.

B. Cellot, and M. Bournaud. Canadian Journal of Zoology CJZOAG, Vol. 66, No. 22, p 352-363, February 1988. 9 fig. 2 tab, 53

Descriptors: *Aquatic life, *Aquatic animals, Descriptors: "Aquate line, "Aquate animars, 'Rivers, "Hydrology, Macroinvertebrate, Insects, Annelids, Crustaceans, Planaria, Distribution, Spa-ital distribution, Temporal distribution, Seasonal variation, Reservoir cleaning, Statistical methods, Correspondence analysis, Artificial substrates, Rhone River, France.

The movements of macroinvertebrates in the Rhone River were studied by using suspended artificial substrates that were immersed for 7 days at three depths near a bank and at the center of the at three depths near a bank and at the center of the channel at Jons (27 km upstream of Lyon France). Sampling was carried out monthly on an annual cycle, from December 1978 to March 1980. The 93 taxa found were distributed as follows: chironomid taxa found were distributed as follows: chironomia larvae (Diptera), 34.4%; Hydropsyche spp. (Tri-choptera), 24.9%; Oligochaeta, 15.7%; Gammarus fossarum and (or) G. pulex (Crustacea), 15.0%; others, 10.0%. Correspondence analysis revealed and summarized the hierarchy of the spatio-temporal variations in fauna. The first level of variation is seasonal and shows contrasts between some summer species (e.g., Ephemerella ignita, Leuctra fusca) and the pool of organisms that subsist during winter. The second level of variation is due to seasonal hydrological conditions. The large flow

rate during winter and at the beginning of the summer instigates the drift of rheolithophilous (e.g., Psychomyia pusilla) or limnophilous (Ascellus aquaticus) taxa, which results in a more intense spatial homogenization of the fauna. The first increase in flow rate after a slower regime, although minor, has a 'washing out' effect on the backwaters connected with the main stream (naraontamic minor, has a 'washing out' effect on the backwaters connected with the main stream (parapotamic area). However, the slower rate at the end of summer is favorable to some extent for some lentic taxa (Planaria), particularly near the banks. A third level of variation, less important, concerns transverse movements (between bank and channel) and the effects of emptying and cleaning the upstream reservoir. (Author's abstract)

W88-08385

FISH SPECIES ASSEMBLAGES IN SOUTH-WESTERN WISCONSIN STREAMS WITH IM-PLICATIONS FOR SMALLMOUTH BASS PLICATIONS FOR MANAGEMENT, Wisconsi

MANAGEMENT, Wisconsin Dept. of Natural Resources, Madison. J. Lyons, A. M. Forbes, and M. D. Staggs. Wisconsin Department of Natural Resources Technical Bulletin No. 161, 1988. 25 p, 10 fig, 7 tab, 75 ref, append.

Descriptors: *Fish, *Species diversity, *Wisconsin, *Streams, *Bass, *Fish management, Species composition, Habitats, Population dynamics.

In order to understand better the community ecology of southwestern Wisconsin stream fishes, particularly in relation to the smallmouth bass, a series of univariate and multivariate statistical were performed on data collected in the 1970s by were performed on data collected in the 1970s by Bureau of Research (Wisconsin Department of Natural Resources) personnel during the statewide Fish Distribution Survey. Fish species assemblages in southwestern Wisconsin streams generally overlapped in species composition and habitat use. One group of fishes was primarily restricted to headwater areas and small tributary streams (< 10 ft maximum width) and another larger assemblage of fishes was usually found only in the largest streams sampled (30-100 ft maximum width). However, most species were encountered over a wide range of stream sizes, several species were found at more than two-thirds of all stations sampled, and species composition changed gradually rather than abruptly from headwaters to downstream areas. Smallmouth bass were most closely associated with rosyface shiners and stonecats, and to a lesser extent mouth bass were most closely associated with ro-syface shiners and stonecats, and to a lesser extent with hornyhead chubs, sand shiners, and golden redhorse. The presence or absence of most of these species at a location appeared to be a good indica-tion of the potential of that location to support smallmouth bass. Stream size (width and depth), amount of rocky substrate, and water temperature were the most important environmental variables associated with the presence/absence of the small-mouth bass and its associates; all 6 species were most frequently found in portions of streams wider than 20 ft that had more than 40% of the bottom as rocky substrate and water temperatures > 60 F (in rocky substrate and water temperatures > 60 F (in May and June). Results suggest that efforts to restore declining smallmouth bass populations in southwestern Wisconsin streams should focus on integrated management of land use in the watershed, particularly in riparian areas, rather than extensive instream habitat modification. (Author's abstract) W88-08425

PRESENT STATE, CHANGES AND QUALITY OF SOLOGNE AND BRENNE, TWO FRENCH LARGE WETLANDS, STUDIED WITH THE MSS AND TM LANDSAT DATA,

Ministere de l'Environnem Neuilly-sur-Seine (France). M. Lenco, and J. P. Dedieu ent et du Cadre de Vie,

M. Lenco, and J. P. Dedieu.
IN: Europe from Space. Proceedings of an ESA/
EARSeL Symposium held in Conjunction with
EARSeL's General Assembly at the Technical
University of Denmark, Lyngby, June 25-27, 1986.
Report No. SP-258, December 1986. p 259-261, 2

Descriptors: *Remote sensing, *Wetlands, *Data interpretation, *Satellite technology, *France, Car-

Lakes-Group 2H

tography, Mapping, Ponds, Landsat, Aquatic vegetation, Turbidity, Water temperature.

The aim of this study carried out in 1985, was to gain knowledge about the present state and the late changes of ecozones and land cover of the waterchanges of econies and tand cover of the water-shed and the water areas of Sologne and Brenne, which are two large wetlands of 130,000 and 145,000 he axtent, respectively, situated in the center of France below the Loire river. Landsat TM and MSS data, the study yields cartographical (at 1/50,000 scale) and numerical information in 23 (at 1/50,000 scale) and numerical information in 23 classes on the present state and the late 1975/84 changes of the watershed land cover of these wetlands. In addition, Landsat TM data processing, supervised classification, have mapped information about depth, aquatic vegetation, turbidity and outer temperatures of the ponds, to ascertain thresholds in channels 5, 1, 2, 3 and 6. (See also W88-08470) (Lantz-PTT) W88-08480.

PHOTOCHEMISTRY OF ENVIRONMENTAL AQUATIC SYSTEMS. Miami Univ., FL.

For primary bibliographic entry see Field 5B. W88-08526

PHOTOLYSIS OF PHENOL AND CHLORO-PHENOLS IN ESTUARINE WATER, Georgia Univ., Athens. Dept. of Microbiology. For primary bibliographic entry see Field 5B. W88-08528

EFFECTS OF ELEVATED CO2 ON CHESA-PEAKE BAY WETLANDS: II. GAS EXCHANGE AND MICROENVIRONMENT IN OPEN TOP CHAMBERS,

Smithsonian Institution, Edgewater, MD. Chesa-peake Bay Center for Environmental Studies. B. G. Drake, W. Arp, J. Craig, P. S. Curtis, and P.

Available from the National Technical Information Service, Springfield, VA 22161, as DE87-010309. Price codes: A06 in paper copy, Ao1 in micro-fiche. Response of Vegetation to Carbon Dioxide, No. 038. Report No. DOE/ER/60374-T3, 1987. 97 p, 33 fig, 6 tab, 31 ref, 2 append.

Descriptors: *Wetlands, *Carbon dioxide, Gas exchange, Air temperature, Field tests, Ecosystems, Solar radiation, Light, Carbon, Vegetation, Chesapeake Bay.

To study the effects of increasing atmospheric concentrations of carbon dioxide, the 1986 growing season was devoted to constructing and testing ing season was devoted to constructing and testing a system for producing test atmospheres of elevated CO2 concentration in salt marsh vegetation in the Chesapeake Bay Wetlands. The species composition of these communities is ideal for testing the sition of these communities is ideal for testing the effects of elevated CO2 on community structure: two are monospecific and the third contains the two species of the monocultures. The two major species differ in the capacity to respond to CO2: one is a C sub 3 sedge, Scirpus olneyii, and one is the C sub 4 grass, Spartina patens. Another C sub 4 grass Distichlis spicata, also occurs in the muse community. Construction and performance of the community. Construction and performance of the four system components: exposure chambers, CO2 dispensing, gas sampling and measuring circuit, and data acquisition and management are de-scribed. Air temperature within the open top chambers averaged 1.8 C higher than air tempera-ture outside the chambers. Canopy temperature inside the open top chambers measured by infrainside the open top chambers measured by infra-red radiation thermometers were within + or -1.0 of canopy temperatures outside the open top cham-ber during the day. Net CO2 exchange followed incident light levels very closely, enabling the con-struction of light response curves for communities under ambient and +260 CO2 concentrations. Maximum net ecosystem CO2 exchange (NCE) was relatively high in September in all three ambi-ent communities, declining thereafter until the end of the measurement period in November. The Spartina community consistently had the lowest NCEmax. Single leaf measurements of NCE and light response characteristics were similar to previ-ously reported data. Data from +260 communities

were more limited but they indicated an increase in NCEmax in all community by +260 Co2 concentrations. Twenty-four hour NCE was positive in all communities in September, becoming negative in October. Preliminary results from +260 communities suggested that elevated CO2 improved the daily carbon budget, possibly extending the period of positive net daily CO2 uptake later into the season. (Lantz-PTT) W88-08541

ALGAL BIOMASS UNALTERED BY FOOD-WEB CHANGES IN LAKE MICHIGAN, Michigan Univ., Ann Arbor. Dept. of Biology. J. T. Lehman.

Nature NATUAS, Vol. 332, No.6164, p 537-538, April 1988. 2 fig, 2 tab, 19 ref.

Descriptors: *Oligotrophic lakes, *Zooplankton, *Cladocera, *Lake Michigan, *Lakes, *Biomass, *Algae, *Food chains, Lake ecology, Food web relations, Predation, Trophic level, Crustacea, Chlorophyll, Limnology.

Bythotrephes cederstroemii Schoedler (Crustacea: Cladocera), a predator previously confined to the Palearctic, has successfully invaded the north American Great Lakes. Bythotrephes is a voracious predator on herbivorous Cladocera, including the dominant grazers on Lake Michigan during the summer. Lake Michigan has been the source of active debate regarding the relative importance of nutrient income versus food-web relations to its rophic state and water quality. The recent species invasion has directly altered the lake's food web at a middle trophic level. During summer 1987 Bythotrephes populations increased rapidly in the offshore regions of Lake Michigan and abundances of herbivorous zooplankton simultaneously declined. Despite the resulting relaxation of herbivory, particulate chlorophyll concentrations, an index of algal biomass, did not increase. These results sugeset that primary producers are most constrained Bythotrephes cederstroemii Schoedler (Crustacea: gest that primary producers are most constrained by abiotic forces in this deep oligotrophic lake. (Author's abstract) W88-08560

EFFECTS OF SODIUM PENTACHLORO-PHENATE ON THE ECOLOGY OF A FRESH-WATER MODEL ECOSYSTEM, Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Botanik, Lehrgebeit Systematik und Oe-loenwisiehen.

For primary bibliographic entry see Field 5C. W88-08565

APPLICATION OF TWO-DIMENSIONAL WATER QUALITY MODEL,

Environmental Protection Agency, Athens, GA. For primary bibliographic entry see Field 5G. W88-08572

ASSESSMENT OF PHOSPHORUS SOURCES TO BLACK LAKE, NEW YORK,

Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5B. W88-08573

IMPROVED MICROCOSM DESIGN FOR PER-FORMING RESERVOIR WATER QUALITY IN-VESTIGATIONS,

Nevada Univ., Reno. Dept. of Civil Engineering. For primary bibliographic entry see Field 5A. W88-08581

HEAVY METALS IN LAKE KINNERET (ISRAEL): II. HYDROGEN SULFIDE DEPEND-ENT PRECIPITATION OF COPPER, CADMI-UM, LEAD AND ZINC,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie. T. Frevert.

Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 1-24, March 1987. 6 fig, 3 tab, 23 ref. Deutsche Forschungsgemeinschaft (Fr 596/1-1).

Descriptors: *Sediments, *Hydrogen sulfide, *Lake Kinneret, *Limnology, *Heavy metals, Sediment-water interfaces, Chemical precipitation, Hydrogen ion concentration, Cycling nutrients, Seasonal variation, Copper, Cadmium, Lead, Zinc, Lakes, Anodic stripping voltammetry, Stratifica-

Heavy metal interchange experiments with natural sediment-water systems from the northern and southern part of Lake Kinneret were carried out under constant temperature, pH2S and pH feedback controlled conditions at the sediment surface and in the overlying water respectively. For some back controlled conditions at the sediment surface and in the overlying water, respectively. For sen-soring pH2s(H2S concentrations) a potentiometric glass/Ag2S semi-microelectrode cell without liquid junction was used at the sediment-water interface position. H2s(pH2S) was also measured interface position. HZS(pHZS) was also measured in the overlying water. Certain proportions of heavy metal solutions (ZnCl2, CdCl2, PbCl2, CuCl2) were added stepwise into the overlying water and the subsequent uptake or release were observed by differential pulse anoxic pH values and HZS concentrations, as were found in situ in the lake, were regulated, the added metals were immediately removed from the solution particulated. diately removed from the solution, particulated and probably precipitated as MeSx (aq) complexes into the sediment. Particularization was greatest with Zn and least with Cd. After reaeration Zn was most rapidly. Po and Cu only slowly (the latter mostly in particulate fraction) released from the sediment. It is concluded that, assuming similar mechanisms in the lake during its annual oxic-anoxic cycling, Cu and Zn should rapidly be fixed into the sediment during summer stagnation; unlike Zn, Cu will only be released after longterm oxic conditions are established at the sediment-water interface. It is consequently evidenced that the sediment may contribute to the pelagial metal concentrations after winter overturn of the lake. (Author's abstract) thor's abstract) W88-08582

DISTRIBUTION AND RELATIVE ABUN-DANCE OF THE NILE PERCH (LATES NILO-TICUS (L.) PISCES: CENTROPOMIDAE) IN LAKE KAINJI, NIGERIA,

Kainii Lake Research Inst., New Bussa (Nigeria). J. K. Balogun.

Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 25-38, March 1987. 6 fig. 3 tab, 19 ref.

Descriptors: *Reservoirs, *Lake Kainji, *Nile perch, *Dam effects, *Population dynamics, *Lim-nology, *Aquatic habitats, Spatial distribution, Species composition, Seasonal variation, Fish, Lakes, Nigeria.

The spatial distribution and relative abundance of Lates niloticus in Lake Kainji, Nigeria before and after the impoundment is discussed. L. niloticus, a freshwater species and the only member of the Centropomidae in Kainji occupies all stretches of River Niger and the lake. Along the inshores, juveniles of Lates prefer habitats of wooded creeks where the bottom is muddy or rocky with gravels, and shallow (< 10 m) with emergent vegetation. In the open water, juveniles of Lates are more abundant in shallow regions with emergent vegetation while the large sized Lates are frequently obtained from stretches of deep water and in regions of medium to great depth (> 10 m). The impact of the impoundment increased the initial low population of Lates. Experimental gill-netting proves more rewarding during the low water level period (May - September) than any other period of the year. (Author's abstract)

LAKE EFFECT ON STREAM LIVING BROWN TROUT (SALMO TRUTTA).

Miljoeverndepartementet, Kristiansand (Norway). O. Haraldstad, B. Jonsson, O. T. Sandlund, and T.

Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 39-48, March 1987. 4 fig, 2 tab, 17 ref.

Descriptors: *Downstream effects, *Eutrophic lakes, *Trout, *Streams, *Lakes, *Limiting nutri-

Group 2H-Lakes

ents, *Limnology, Fish physiology, *Aquatic habitats, *Population dynamics, Food habits, Zooplankton, Seasonal variation, Fish, Growth, tats, *Pop plankton, Norway.

The effects on brown trout caused by nutrient rich lake water in outlet streams were tested. Feeding, growth, density, and wintering of trout living in streams running into and out of lakes in two Norstreams running into and out of lakes in two Norwegian water courses were compared. In the outlet streams zooplankton and filter feeders were important food items, whereas in the inlet streams, surface insects were the most important food during the ice-free season. In the Osen water course, where migration between outlet stream and lake was prevented, fish growth and density was higher in the outlet than in the inlet stream. In the Voss River course, where the trout freely migrated between outlet, lake, and inlets, the trout density was higher in the outlet than in the inlet streams, especially during winter. No growth differences were observed. (Author's abstract)

THREE DAY STUDY OF THE DIEL BEHAVIOR OF PLANKTON IN A HIGHLY HUMIC AND STEEPLY STRATIFIED LAKE, Helsinki Univ., Lammi (Finland). Lammi Biologi-

cal Station.
L. Arvola, K. Salonen, R. I. Jones, A. Heinanen,

and I. Bergstrom. Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 89-106, March 1987. 14 fig, 2 tab, 22 ref.

Descriptors: *Plankton, *Stratification, *Spatial distribution, *Population dynamics, *Species composition, *Limnology, *Seasonal variation, *Primary productivity, Light quality, Chlorophyll, Ecological effects, Lakes.

The diel interactions between the vertical distribution of different plankton components and the physical and chemical characteristics of water physical and chemical characteristics of water were studied through three consecutive diel cycles (54 h) in a highly humic and steeply stratified small lake. The density of bacterioplankton in the epilimon showed little diurnal fluctuation. Some phytoplankton, particularly cryptomonads, exhibited clear diurnal migration. The diel productivity of phytoplankton closely followed the fluctuations in the illumination. However, in terms of chlorophyll and illumination primary productivity was highest early in the morning. In the zooplankton, a rotifer Polyarthra was present in the epiliminion by day and descended to deeper layers by night, whereas the cladoceran, Holopedium, had an opposite migration pattern with a subsurface maximum at night. The Cladocerans Bosmina and Daphnia may have migrated horizontally. In general the diel patterns found in the plankton showed consistency over the 3 successive del cycles. This reflected the high degree of stability in the main forcing environmental variables, especially light intensity. (Author's abstract) thor's abstract)

PATTERN OF ORGANIC MATTER PRODUC-TION BY NATURAL PHYTOPLANKTON POP-ULATION IN A EUTROPHIC LAKE: 1, INTRA-

CELULAR PRODUCTS,
Nagoya Univ. (Japan). Water Research Inst.
T. Hama, and N. Handa.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109,
No. 1, p 107-120, March 1987. 5 fig, 3 tab, 19 ref.

Descriptors: "Cyanophyta, "Organic matter, "Eutrophic lakes, "Phytoplankton, "Limnology, "Primary productivity, Culturing techniques, Eutrophication, Aquatic habitats, Lakes, Algae, Carbohydrates, Photosynthesis, Long-term studies, Short-term studies, Lipids, Proteins.

Photosynthetic products of natural phytoplankton population dominated by blue-green alga, Microsystis aeruginosa, was determined by long- and short-term incubations. Carbohydrates were the main photosynthetic products and they accounted for 72% of the total daily production. The comparison of photosynthetic products determined by long- and short-term incubations revealed that long-term incubation reflected the net production

rate, whereas the value determined by short-term incubation was close to gross production rate. The specific production rate of carbohydrates was special production rate of carbohydrates was higher than proteins and lipids in daytime, howev-er, almost equal values were obtained after 24 h incubation through day and night time. This bal-anced production of organic matter was due to the exclusive loss of carbohydrates in nighttime. (Au-thor's abstract) W88-08586

BACTERIA AS STRUCTURING AGENTS IN LAKES: FIELD MANIPULATIONS WITH BACTERIOPLANKTON, Ottawa Univ. (Ontario). Dept. of Biology. R. Newhook, and F. Briand.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 1, p 12-138, March 1987. 6 fig, 2 tab, 49 ref. NSERC Grant (A 3011).

Descriptors: *Bacterioplankton, *Heney Lake, *Diatoms, *Biomass, *Limnology, *Phytoplankton, *Zooplankton, *Cycling nutrients, *Limiting nutrients, *Aquatic habitats, Food chains, Species composition, Population dynamics, Lakes, Nutrients, Algae, Culturing techniques, Quebec, Canada.

To investigate the possible role of bacteria in controlling the composition of plankton communities, large enclosures suspended in Hency Lake, Quebec, were experimentally enriched with cultures of the indigenous bacteria Aeromonas hydrochiba tures of the indigenous bacteria Aeromonas nydro-phila anaerogenes and Serratia marcescens. Acci-dentally low levels of enrichment (5% of total densities) produced striking increased in the bio-mass of net phytoplankton (> 30 microns), perhaps as added bacteria preferentially associated with, and regenerated nutrients for, the larger algae. Diatom enhancement was particularly strong, likely reflecting bacterial interference with allelolikely reflecting bacterial interference with allebpathic substances released by blue-green algae.
Phytoplankton stimulation in turn raised the levels
of epilimnetic oxygen, and lowered those of ammonia. Bactivorous and carnivorous zooplankton
were significantly increased in those enclosures
where the added bacteria apparently reproduced
best. Plankton species composition was most sensitive to bacterial additions when the pelagic community approached a steady state with regard to
relative abundance. At such times, the bacteria
studied were involved not just in recycling nutrients, but also mediated higher-order interactions.
(Author's abstract)
W88-08587

BIOLOGICAL SURVEILLANCE OF WATER QUALITY: 2. TEMPORAL AND SPATIAL VARIATION IN THE MACROINVERTEBRATE FAUNA OF THE RIVER FROME, A DORSET

FAUNA OF THE RIVER FROME, A DORSET CHALK STREAM, Freshwater Biological Association, Wareham (England), River Lab. L. C. V. Pinder, and I. S. Farr. Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 3, p 321-331, May 1987. 5 fig, 3 tab, 13 ref.

Descriptors: *Species diversity, *River Frome, *Macroinvertebrates, *Limnology, *Spatial distribution, *Temporal distribution, *Water quality, Chemical analysis, Comparison studies, Species composition, Aquatic habitats, Rivers, Stream order, United Kingdom.

Samples of macroinvertebrates were taken at 5 sites, over a 40 km stretch of the River Frome, over a period of 18 months. Chemical analyses of water, from the same or nearby sites, were also carried out periodically. Chemical analyses were indicative of lower water quality at the most upstream site, and 3 of the 4 calculated biotic scores also indicated lower water quality at this site. The exception was the Average Chandler Score per Taxon, which failed to discriminate between any of the sites. In contrast, diversity was lower at the naxon, which tailed to discriminate between any of the sites. In contrast, diversity was lower at the 2 most upstream sites, which suggests that, over the range of conditions encountered, diversity was influenced by 'stream order' to a greater extent than by water quality. (See also W88-08595) (Author's abstract)
W88-08588

ACIDIFICATION OF A DUTCH MOORLAND POOL: A PALAEOLIMNOLOGICAL STUDY. Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.

M. D. Dickman, H. van Dam, B. van Geel, A. G. Klink, and A. van der Wijk. Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 3, p 37-408, May 1987. 12 fig, 2 tab, 60 ref. European Community Contract Nr. ENV-650-N.

Descriptors: *Diatoms, *Moorland pools, *Paleo-limnology, *Limnology, *Acidification, *Air pol-lution effects, *Acid rain, Hydrogen ion concentra-tion, Acidic water, Stratigraphy, Pools, Lakes,

The Dutch moorland pool Achterste Goorven is undergoing rapid acidification. In the period 1925-1985 sediment core diatom inferred pH has fallen from 5.8 to 4.8. During the same period observed pH fell from 6 to 4.2 and plankton tow diatom inferred pH fell from 5.7 to 4.2. To date, this is one of the fastest documented rates of acidification of the fastest documented fas of the fastest documented rates of acidification of any pool or lake in temperate regions exposed to acid rain. The results indicate that useful strati-graphic information can be obtained from an analy-sis of the organic sediments of even a very shallow (mean depth 0.6 m) pool. Although there is evi-dence of downward displacement of sediments in such shallow water bodies, this process does not completely homogenize the sediment record. The accuracy of the reconstruction is substantially im-proved by a multidisciplinary approach. (Author's abstract) W88-08589

MEASUREMENTS OF CHLOROPHYLL-A FROM PHYTOPLANKTON USING ETHANOL AS EXTRACTION SOLVENT,

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab. A.-M. Jespersen, and K. Christoffersen.

Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 3, p 445-454, May 1987. 2 fig, 4 tab, 18 ref.

Descriptors: *Ethanol, *Solvent extractions, *Chlorophyll a, *Limnology, *Analytical methods, *Phytoplankton, *Culturing techniques, Spectrophotometry, Algae, Extraction lakes, Methanol.

The use of ethanol as extraction solvent for the determination of chlorophyll-a was evaluated on a variety of cultures and natural populations of phytoplankton. Ethanol was as efficient as methanol in the extraction of chlorophyll-a from cultures or natural populations of lake phytoplankton. An extraction period of 6 hours in cold ethanol was in most cases sufficient to complete the extraction, but longer extraction time or heating the solvent may be necessary when green algae dominate the plankton. The extraction efficiency decreases 10-25%, when water reduced the ethanol concernation from 96% to 83.5%. Interference from chlorophyll-b in the spectrophotometric determination of chlorophyll-a in ethanol comprised 3-9% and should be ignored in routine determinations of chlorophyll-a from phytoplankton. (Author's abstract) stract) W88-08590

BIOINDICATION BY MACROPHYTES - CAN MACROPHYTES INDICATE SAPROBITY (BIOINDIKATION DURCH MAKROPHYTEN -INDIZIEREN MAKROPHYTEN SAPROBIE), Bayerisches Landesamt Munich (Germany, F.R.). Wasser

For primary bibliographic entry see Field 5A. W88-08591

BIOLOGICAL SURVEILLANCE OF WATER QUALITY: 3. THE INFLUENCE OF ORGANIC ENRICHMENT ON THE MACROINVERTE-BRATE FAUNA OF SMALL CHALK STREAMS, Freshwater Biological Association, Wareham (England). River Lab.

For primary bibliographic entry see Field 5A. W88-08595

QUANTITATIVE RESPONSES OF CHIRONOMID COMMUNITIES TO TWO WATER VELOCITY REGIMES DURING A SPRING BLOOM OF EPILITHIC ALGAE,

Freshwater Biological Association, Wareham (England). River Lab.
J. S. Welton, M. Ladle, and J. A. B. Bass.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 4, p 525-539, June 1987. 11 tab, 18 ref. Department of the Environment, Contract No. DGR 480/467.

Descriptors: *Streams, *Water velocity, *Chironomids, *Limnology, *Species composition, Biomass, Eutrophication, Population dynamics, Seasonal variation, Algae, Growth, Artificial water courses.

variation, Algae, Growth, Artificial water courses. A study was carried out in two recirculating stream channels to assess the role of water velocity on the species composition and abundance of chironomids during a bloom of epilithic algae. Eight taxa were present in sufficiently high densities for detailed analysis. Comparisons of abundance and timing of chironomid populations and size of individuals in the two contrasting water velocities are given. During a bloom of epilithic algae, four subfamilies of the Chironomidae were found in two recirculating channels which were operated at two water velocities (0.45 m/s in channel 2 and 0.15 m/s in channel 3). There were 13 taxa of Orthocladinae, 4 Chironominae, 2 Diamesihae and one Tanypodinae. All except four taxa were found at both water velocities. Eight attained population densities in excess of 12,000/sq m with Micropsectra spp. reaching 173,000/sq m in the lower current velocity. A comparison of populations in the two water velocities showed timing differences in the case of Orthocladius sp. A. Generally the Chironominae were inore abundant in channel 3 and the Orthocladius in channel 2. The mean length of larvae was greater in channel 3 and maximum sizes of all abundant species were also found in the lower current velocity. (Alexander-PTT) W88-08596

POPULATION DYNAMICS OF DUCKWEED COVER IN POLDER DITCHES.

Leiden Rijksuniversiteit (Netherlands). Centre for Environmental Studies. For primary bibliographic entry see Field 5C. W88-0859

RADIONUCLIDE LEVELS IN RIVER SEDI-MENT NEAR TO A TREATED EFFLUENT OUTFALL, Ministry of Defence, Aldermaston (England). Atomic Weapons Research Establishment. For primary bibliographic entry see Field 5B. W88-08610

RODERO CREEK; RISING WATER ON THE HIGH DESERT.

Nevada Univ., Reno. Dept. of Range, Wildlife and Forestry.
S. Swanson, D. Franzen, and M. Manning.
Journal of Soil and Water Conservation JSWCA3,
Vol. 42, No. 6, p 405-407, November-December 1987. 6 ref.

Descriptors: *Erosion control, *Rodero Creek, *Grazing, *Wetlands, *Aquatic habitats, *Watershed management, Sage grouse, Streams, Runoff, Water table, Watersheds, Water resources development, Dams, Birds.

The seven miles of perennial stream in the Sheldon National Wildlife Refuge in northwestern Nevada had long stretches of wet meadow where sage grouse flocked in late summer. In this cold desert landscape with long, dry summers, wet meadow habitat is critical. Uncontrolled or season-long cattle grazing often results in severe distribution problems, and riparian areas usually bear the brunt of livestock concentrations. Heavy riparian grazing along Rodero 'Creek probably did little to harm sage grouse directly. But it did adversely affect sage grouse and other wildlife by taking a toll on the stream. Based on previous experience, loose rock check dams designed to leak water and trap sediments in combination with headcut revetments

and livestock exclusion for a few years, followed by livestock management, appeared to be the best treatment. This project apparently will succeed because the watershed behind it is relatively small. because the watershed behind it is relatively small. In spite of the initial success, the real measure of the project will come in 20 years or more. Gully erosion will recur if structures were poorly designed or improperly placed. Even where structures are the best alternative, the design may need modification. In streams with erodable gully banks and periodic high flow, a greater number of low dams may promote recovery more effectively. It may take years for a gully to widen sufficiently for it to accept high flows without significant bank scour. In that time, low structures may create a stable bed for wetland vegetation that can itself aggrade the channel and raise the water table. Whenever structures are required to heal a gully network, the project should proceed upstramafrom a point of geologic control as near the top of the watershed/gully system as possible. It is ideal to work just below the deterioration so that watershed stabilization comes soon. Without geologic or other durable control, however, it is possible for a downstream headcut to move upstream and capture the bottom and eventually other dams. (Alexander-PTT) In spite of the initial success, the real mea ander-PTT) W88-08621

DISTRIBUTION AND SEASONAL CHANGES OF AQUATIC OLIGOCHAETA IN LAKE SUWA,

Suwa, Magano-ken Junior Coll., Miwa (Japan). K. Yasuda, and T. Okino. Japanese Journal of Limnology RIZAA, Vol. 48, No. 1, p 1-8, January 1987. 10 fig, 1 tab, 11 ref.

Descriptors: *Limnology, *Seasonal variation, *Vertical distribution, *Lake Suwa, *Oligochaetes, Species composition, Population dynamics, Population density, Spatial distribution.

Ten species of aquatic Oligochueta were identified in Lake Suwa, Japan. Limnodrilus hoffmeisteri and Limnodrilus chaparedeianus were obtained from every station and were the most abundant species. Their density the depth. The second most abundant species, Rhyacodrilus sp., was collected in a region shallower than 4 m depth. A study on the seasonal changes in the density of Limnodrilus spp. (L. hoffmeisteri and L. claparedeianus) and Rhyacodrilus sp. clearly exhibited a decrease in summer and an increase in winter and spring. Lake Suwa codrilus sp. clearly exhibited a decrease in summer and an increase in winter and spring. Lake Suwa was divided into three regions in terms of the depth distribution of aquatic Oligochaeta, namely, a region deeper than 5 m, a transitional region from 3 to 4 m, and a region shallower than 2 m. The seasonal changes in the density and depth distribution of aquatic Oligochaeta are discussed with respect to the environmental condition of the lake bottom and the reproductive state of the Oligochaeta. (Author's abstract) W88-08628

EDDY DIFFUSIVITY IN THE HYPOLIMNION IN LAKE KANNA, Gunma Univ., Maebashi (Japan). Faculty of Edu-

A. Sugawa. Japanese Journal of Limnology RIZAA, Vol. 48, No. 1, p 9-17, January 1987. 9 fig, 3 tab, 12 ref.

Descriptors: *Eddy diffusion, *Hypolimnion, *Lake Kanna, *Water temperature, *Reservoir releases, Intake gates, Temperature gradient, Dam effects, Vertical distribution, Reservoirs.

Lake Kanna in Onishi, Japan is a reservoir. The dam intake moves up and down with the lake surface, and the surface water is discharged through the intake. In this case the vertical distrithrough the intake. In this case the vertical distri-bution of water temperature is similar to that of a natural lake. When a large amount of water is supplied rapidly into Lake Kanna, the lake water is discharged not only through the intake, but through the dam gate. The gate is usually situated below the lake surface. In this case eddy diffusion in the lake water is affected by the discharge, and the vertical distribution of water temperature is different from that of a natural lake. The relation-ship between the values of the eddy diffusivity in ship between the values of the eddy diffusivity in

the hypolimnion and the summation of the average daily discharge rate over time is roughly linear when plotted on a logarithmic scale. (Author's W88-08629

CIRCULATION AND WATER BALANCE OF LAKE SAINO-KO IN NIKKO, (IN JAPANESE), Rissho Univ., Tokyo (Japan). Dept. of Geography.

Japanese Journal of Limnology RIZZA, Vol. 48, No. 1, p 25-32, January 1987. 8 fig, 13 ref.

Descriptors: "Hydrologic budget, "Water circula-tion, "Balancing reservoirs, "Saino-ko Lake, "Leakage, "Water levels, Water loss, Water tem-perature, Dissolved oxygen, Chemical analysis, Gravel, Seasonal variation, Precipitation.

Investigations on water balance, water tempera-Investigations on water balance, water temperature, dissolved oxygen and other chemical analyses were made for Lake Saino-ko, Nikko, Japan, from May 1980 to April 1983. The results are as follows: (1) As estimated by electric prospecting of the geology around the lake, the lake was dammed by coarse gravel from the river. Because of this permeable material in the downstream section, the water level of the lake shows a wide seasonal variation. In winter, the level falls by about 11 m compared with that of early summer, and the water surface area and the water volume decrease to 1/2 and 1/6 respectively. (2) The rate of leakage from the lake is estimated from the water balance in winter when noticeable inflow is not observed. from the lake is estimated from the water balance in winter when noticeable inflow is not observed. A high rate of leakage is obtained at a high water level and vice versa. (3) In summer, the water level has a close relationship to the effective pre-cipitation. The equilibrium water level in summer is estimated to be 13.3. m. (4) Water circulation is effective in the shallow layer as deduced from effective in the shallow layer as deduced from dissolved oxygen and water temperature. This may be influenced by the position of leakage. A phe-nomenal circulation was observed during and after floods. (Author's abstract) W88-08631

CHARACTERISTICS OF GENERIC COMPOSITION OF AEROBIC HETEROTROPHIC BACTERIA IN PERIPHYTON AT AN OLIGOTROPHIC REGION IN THE TAMAGAWA RIVER, Tokyo Univ. of Agriculture and Technology (Japan), Lab. of Biology. K. Morikawa.

Japanese Journal of Limnology RIZAA, Vol. 48, No. 1, p 55-65, January 1987. 3 fig. 4 tab, 25 ref.

Descriptors: *Species composition, *Bacteria, *Heterotrophic bacteria, *Aerobic bacteria, *Periphyton, *Oligotrophy, *Tamagawa River, Bacterial analysis, Seasonal variation, Color, Algae.

The bacterial generic composition in the periphyton at an oligotrophic region in the Tamagawa River, Japan was studied during different seasons and in different colored periphyton. Shannon's di-versity index of bacterial generic composition was highly correlated to the amount of chlorophyll in highly correlated to the amount of chlorophyll in the periphyton. In the bacterial generic composi-tion of brownish periphyton mainly composed of Bacillariophyta, yellowish brown Cytophaga sp. (represented as Cytophaga (yb)) was the predom-nant bacterial group in summer, and red Flavobac-terium sp. (Flavobacterium (r)) in winter and spring. Greenish periphyton contained Ulothrix zonata in addition to Bacillariophyta, and small sellow Flavobacterium sp. (Flavobacterium (sv.)) zonata in addition to Bacillarionpitya, and small yellow Flavobacterium sp. (Flavobacterium (sy)) was predominant. Cytophaga (yb) was accompanied by the exponential growth phase of Cymbella sp., and Flavobacterium (r) predominated only under low nutritional conditions when other bacterial groups could not grow. Flavobacterium (sy) was observed with Ulothrix zonata and Naviclua was observed with Ulothrix zonata and Navictua spp., but the appearance of this group was paralleled by an increase in the total bacterial number. As a result, it predominated when a larger number of bacteria were present. Bacterial generic groups in the river region studied were divided into three categories: (i) those groups existing primarily in running water, (ii) those mainly inhabiting the peri-

Group 2H-Lakes

phyton, and (iii) those consistently isolated from both periphyton and running water. (Author's abstract) W88-08633

SPECIES COMPOSITION OF PHYTO- AND ZOO-PLANKTON COMMUNITIES IN FERTILIZED AND NON-FERTILIZED PADDY FIELDS, (IN JAPANESE),

Shiki High School, Saitama (Japan).

M. Taira, and K. Hogetsu. Japanese Journal of Limnology RIZAA, Vol. 48, No. 2, p 77-83, April 1987. 4 fig, 5 tab, 15 ref.

Descriptors: *Phytoplankton, *Zooplankton, *Species composition, *Paddy fields, *Rice, *Fertilizers, Seasonal variation, Ammonium, Phosphate, Flood irrigation, Japan, Agricultural chemicals.

Flood irrigation, Japan, Agricultural chemicals.

Seasonal changes of numbers and species composition of phyto- and zoo-plankters in fertilized and non-fertilized paddy fields were surveyed from June to September, 1982, at Saitama Agricultural Experiment Station, Kumagaya, Saitama Prefecture, Japan. Both fields had been irrigated with a small channel from the River Arakawa; experiments on the effects of fertilizers on the growth of rice plants have been made since 1904. The fertilized field was treated with about 123 g N and 4 g P/cu m in June. Concentrations of NH4-N and PO4-P, and numbers of phyto- and zoo-plankters were higher in the fertilized field than the non-fertilized one. The following sequence of the dominant groups was observed in the non-fertilized field: Bacillariophyceae — Cyanophyceae — Cyanophyceae — Chlorophyceae in the fertilized field was characterized by the appearance of Chlorophyceae — Bacillariophyceae — Chlorophyceae following sequence of Chlorophyceae — Bacillariophyceae — Collorophyceae — Collorophyceae — Chlorophyceae — Chloro was characterized by the appearance of Chloro-phyceae (mainly Scenedesmus sp.) in summer. Sea-sonal changes of the dominant zooplankters are no different between the two fields and divided into the following three periods: Protozoa, Crustacea and Rotifera period. (Author's abstract)

SEASONAL CHANGES OF UROGLENA AMERICANA IN LAKES CHUZENJI-KO AND YUNO-KO, (IN JAPANESE),

Tochigi Prefectural Research Inst. for Environ-mental Pollution, Utsunomiya (Japan).

J. Koyama, K. Fukuda, and N. Kobayashi. Japanese Journal of Limnology RIZAA, Vol. 48, No. 2, p 85-90, April 1987. 4 fig, 3 tab, 15 ref.

Descriptors: *Seasonal variation, *Uroglena americana, *Odor-producing algae, Chuzenji-ko Lake, Yuno-ko Lake, Japan, Vertical distribution, Odos, Water pollution sources, Seasonal variation, Lakes,

Seasonal changes and vertical distribution of Uroglena americana, which is known to cause a fishy odor in tap waters, were surveyed in the Japanese Lakes Chuzenji-ko, Yuno-ko, and the mouth of the Yukawa River, which connects the two lakes, from 1983 to 1983. Remarkable increases in the cell numbers of U. americana were observed from the end of May to the middle of June in Lake Yuno-ko and from the end of June to the middle of July in Lake Chuzenjiko. The fishy dor of tap water. Lake Chuzenji-ko. The fishy odor of tap water, when Lake Chuzenji-ko was its source, occurred during the same time as the blooming of U. ameri-cana in 1983. The maximum cell numbers of U. americana were observed at the surface layer in Lake Yuno-ko and at a depth of about 10 m in Lake Chuzenji-ko, where the river water flowed into water of the same temperature layer during May to July, suggesting that most of U. americana might flow into Lake Chuzenji-ko through the might flow into Lake Chuzenji-ko firough the Yukawa River and grow there. Since Lake Yuno-ko has sufficient nutrient levels for growth of U. americana and the water temperature from June to October is nearly 15 C, a condition favoring growth of U. americana, Lake Yuno-ko would have supplied U. americana for Lake Chuzenji-ko for a long period. (Author's abstract) W88-08635

IMPROVED EKMAN-BIRGE GRAB FOR SAM-PLING AN UNDISTURBED BOTTOM SEDI-MENT CORE SAMPLE,

Niigata Univ. (Japan). Biological Lab. For primary bibliographic entry see Field 7B. W88-08638

H2 PRODUCTION BY A LARGE PHOTOTRO-PHIC BACTERIUM ISOLATED FROM THE BACTERIAL PLATE OF LAKE KAIIKE, Nagasaki Univ. (Japan). Faculty of Fisheries M. Matsuyama.

Japanese Journal of Limnology RIZAA, Vol. 48, No. 2, p 133-136, April 1987. 4 fig, 9 ref.

Descriptors: *Hydrogen, *Phototrophism, *Photosynthetic bacteria, *Bacteria, *Lake Kaiike, Japan, Nitrogen fixing bacteria, Bacterial physiology.

A large-celled phototrophic bacterium, which densely populates the O2-H2S interface of Lake Kaiike (Kamikoshiki Island), vigorously produced H2 during growth. The H2 production was intimately associated with photosynthesis. In situ H2 production and N2 fixation at the bacterial plate (November 1986) were quite low. But when the same sample was incubated after supply with neutralized Na2S-H2O solution under the light, it seems to be produced selected rates of both processes. It seems traitzed Na23-97120 Soutton under the ignt, it showed elevated rates of both processes. It seems probable that the H2 production is a necessary bacterial process, but H2 produced by the bacterium has some effect on the establishment of the microbial community at the bacterial plate of Lake Kailke. (Author's abstract)

MACROBENTHIC FAUNAS OF TWO BRACK-ISH LAGOONS WITH DIFFERENT SALINITY IN KAMIKOSHIKI ISLAND, PREFECTURE, (IN JAPANESE),

Tokyo Univ. (Japan). Dept. of Geography. For primary bibliographic entry see Field 2L. W88-08640

SEASONAL CHANGES OF ORGANOPHOS-PHOROUS AND ORGANONITROGENOUS COMPOUNDS HYDROLASE ACTIVITIES IN

IIDABORI POND,
Science Univ. of Tokyo (Japan). Faculty of Pharmaceutical Sciences.

For primary bibliographic entry see Field 5B. W88-08642

LIGHT-LIMITED GROWTH OF A LARGE PHOTOTROPHIC BACTERIUM DOMINATING AT THE DISSOLVED 02-H2S INTERFACE OF LAKE KAIIKE,

Nagasaki Univ. (Japan). Faculty of Fisheries. M. Matsuyama.

M. Matsuyama. Japanese Journal of Limnology RIZAA, Vol. 48, No. 3, p 203-209, July 1987. 6 fig, 17 ref.

Descriptors: *Lakes, *Photosynthetic bacteria, *Limiting factors, *Light intensity, *Phototropism, *Bacterial physiology, *Kaiike Lake Japan, Dissolved oxygen, Hydrogen sulfide, Interfaces, Population dynamics.

A large-celled phototrophic bacterium isolated from the dissolved O2-H2S interface of Lake Kaiike was continuously cultured under light-limited conditions. The bacterial number at the interface was so large that incident light was rapidly extinguished. Most bacterial cells seem to barely maintain cell-integrity due to light limitation. The bacterium had a specific growth rate as small as -0.003/hr in the dark. In situ measurements of N2 fixation and H2 evolution at the bacterial plate of Lake Kaiike revealed very low rates, although the Ination and H2 evolution at the bacterial plate of Lake Kaiike revealed very low rates, although the large-celled phototrophic bacterium in vitro as well as in the bacterial plate sample showed significantly elevated rates when they were exposed to a high light intensity after supply with H2S. This fact suggests that the large-celled phototrophic bacterium can maintain its dense population by maintaining minimal physiological activity. (Ver-nooy-PTT)

DENITRIFYING ACTIVITY AND POPULA-TION GROWTH OF DENITRIFYING BACTE-RIA IN LAKE FUKAMI-IKE,

Nagoya Univ. (Japan). Water Research Inst. H. Terai, M. Yoh, and Y. Saijo.

Japanese Journal of Limnology RIZZA, Vol. 48, No. 3, p 211-218, July 1987. 6 fig, 2 tab, 12 ref. Ministry of Education, Science and Culture of Japan, Grant-in-Aid for Scientific Research No. 59540420.

Descriptors: *Limnology, *Lakes, *Denitrifica-tion, *Population dynamics, *Nitrogen fixing bac-teria, *Fukami-Ike Lake Japan, *Nitrogen fixation, Dissolved oxygen, Nitrous oxide

In the oxygen-depleted layer of Lake Fukami-ike during March to July in 1985, denitrifying activities were measured by the acetylene blockagemethod, and the denitrifying bacterial population was estimated by the MPN method. Until March 22, no detectable denitrifying activity was found. On April 6, at and below the 5 m depth, lower but distinct denitrifying activities were found. Thereafter, denitrifying activity became higher with time. distinct denitrifying activities were found. Thereatter, denitrifying activity became higher with time.

Maximum activity (0.64 microgram-at N/L/day)
was obtained at a depth of 4.5 m on July 2. In
accordance with the development of denitrifying
activity, the average denitrifying bacterial population increased from 3.9 cells/mL on March 22 to
87 cells/mL on July 2. From the analysis of the
correlation between denitrification and in situ discalled oxygen content. it was shown that denitrisolved oxygen content, it was shown that denitrisolved oxygen content, it was shown that dentifying activity was initiated at 0.25 m L/L dissolved oxygen and increased with the decrease of dissolved oxygen content. It was also shown that the ratio of N2O emission in the total denitrification (N2O/(N2+N2O)) decreased with decreasing in situ dissolved oxygen content. (Author's abstract)

ACTIVE DENITRIFICATION IN THE HYPO-LIMNETIC WATER COLUMN IN LAKE LIMNETIC KIZAKI.

Nagoya Univ. (Japan). Water Research Inst. H. Terai, M. Yoh, and Y. Saijo.

H. Ieral, M. Yon, and Y. Sugo. Japanese Journal of Limnology RIZAA, Vol. 48, No. 3, p 219-224, July 1987. 3 fig. 1 tab, 13 ref. Ministry of Education, Science and Culture of Japan, Grant-in-Aid for Scientific Research No.

Descriptors: *Lakes, *Denitrification, *Nitrogen fixing bacteria, *Hypolimnion, *Kizaki Lake Japan, Nitrous oxide, Vertical distribution.

Denitrifying activities of the water column of Lake Kizaki were estimated by the acetylene blockage method. Active denitrification was detected in the developed anoxic vater column. Maximum activity was estimated to be 2.0 micrograms-at N/L/day at a 24 m depth on December 2, 1984, where maximum nitrous oxide (N2O) accumulation (2.6 maximum nitrous oxide (N2O) accumulation (2.6 micrograms-at N/L) was also observed. Contribution of denitrification as N2O (N2O/(N2+N2O)) was 34% to 49% of the total denitrification in some active denitrifying layers. When the most active denitrifying layers, when the most active denitrifying layers when the most active denitrifying bacteria in the hypolimnion showed an almost exponential increase in number towards the lake bottom. (Author's abstract) W88-08645

PRELIMINARY STUDY ON THE WATER TEMPERATURE AND FREEZING OF LAKE SUWA IN JAPAN AND SHALLOW LAKES IN EASTERN CHINA,

Rissho Univ., Tokyo (Japan). Dept. of Geography. For primary bibliographic entry see Field 2C. W88-08646

BEHAVIOR OF DISSOLVED MANGANESE IN LAKE OHNUMA,
Hokkaido Univ., Hakodate (Japan). Dept. of

Chemistry. For primary bibliographic entry see Field 2K. DISTRIBUTION OF LACTATE, PROPIO-NATE, AND ACETATE-OXIDIZING SUL-FATE-REDUCING BACTERIA IN VARIOUS AQUATIC ENVIRONMENTS, Tokyo Metropolitan Univ. (Japan). Dept. of Biol-

ogy.
For primary bibliographic entry see Field 5B.
W88-08648

STUDIES ON DENITRIFICATION IN THE WATER COLUMN OF LAKE KIZAKI AND LAKE FUKAMI-IKE, Nagoya Univ. (Japan). Water Research Inst. H. Terai.

Japanese Journal of Limnology RIZAA, Vol. 48, No. 4, p 257-264, December 1987. 5 fig, 17 ref. Ministry of Education, Science and Culture of Japan, Grant-in-Aid for Scientific Research No. 61540473.

Descriptors: *Denitrification, *Kizaki Lake, Fukami Lake, *Mineralization, Vertical distribution, Acetic acid, Carbon radioisotopes, Japan, Nitrous oxide, Nitrites.

Denitrifying activities in two freshwater lakes, Lake Kizaki during October to December 1986 and Lake Fukami-ike during July to August 1985 and in July 1986, were estimated by the acetylene blockage method. Relationships between the denitrifying activities and the concentration of denitri-fying intermediates such as NO2(-) and N2O in the tritying activities and the concentration of dentifying intermediates such as NO2(-) and N2O in the water column of the two lakes were analyzed. Denitrifying activity in L. Fukami-like was essentially dependent on the NO2(-) concentration in two ways. A positive correlation was found between the denitrifying activity and in situ NO2(-) concentrations, while in some cases remarkable entirifying activities were found in the NO2(-)-depleted layer and correlated with the maximally accumulated NO2(-) concentration. On the other hand, a better correlation of denitrifying activity with N2O concentration was found in L. Kitziki, Mineralization of 14C-acetate and its coupling with denitrification were also compared in the two lakes. Mineralized 14CO2 plotted against the total uptake of 14C-acetate fell in a regression line with the same slope of 0.34. This was seen not only in the NO3(-)-enhanced uptake of the substrate, but also in both L. Fukami-like (at 44.5 m depth on July 20, 1986) and L. Kizaki (at 21-24 m depth on December 2, 1986). (Author's abstract)

WATER QUALITY FORMATION OF INLAND WATER IN THE DRAINAGE BASIN OF LAKE CHUZENJI, NIKKO, (IN JAPANESE), Tochigi Prefectural Research Inst. for Environmental Pollution, Utsunomiya (Japan).

K. Murakami, H. Sasanuma, J. Koyama, N. Kobayashi, and M. Hirayama.

Japanese Journal of Limnology RIZAA, Vol. 48, No. 4, p 295-306, December 1987. 5 fig, 6 tab, 28 ref.

Descriptors: *Chemical composition, *Springs, *Rivers, *Water quality, *Chuzenji Lake, *Water sampling, *Lakes, Chemical analysis, Calcium bicarbonate, Japan, Inorganic compounds, Hot springs, Phosphates, Nitrates, Theoretical analysis.

Mechanisms of water quality formation in rivers and lake waters were studied in the drainage basin of Lake Chuzenji. Water samples were collected at 15 stations in 9 lakes, 14 in 7 rivers and 16 in springs or wells from April 1983 to November 1984. Chemical analyses of the main inorganic constituents (Na(+), K(+), Ca(++), Mg(++), Cl(-), 304(-), and SiO2(-)) dissolved in the water samples revealed that surface and underground waters in this region are generally low in dissolved samples revealed that surface and underground waters in this region are generally low in dissolved chemical constituents, except for the hot springs on the northern shore of Yunoko (U-3), two springs along Yukawa (U-12, U-13) and Jigokugawa (U-11). Most waters belong to the CaHCO3 type. The water quality of Yunoko is controlled by the qualities of the spring and hot spring waters on the shore of the lake. Jigokugawa (Hell River) has higher concentrations not only of the main constituents, but also of minor PO4-P and NO3-N than other waters in this region except for the hot

spring water. The high concentrations of the main constituents seem to originate from dissolution of spring water. The high concentrations of the main constituents seem to originate from dissolution of volcanic rocks. The water quality calculated theoretically from chemical loads which are brought into Lake Chuzenji through rivers and precipitation shows a good agreement with the measured water quality of the lake water except soluble silica. Soluble silica becomes insoluble due to the biological activity of diatoms. (Author's abstract) W88-08652

EXTENT OF SNOWPACK INFLUENCE ON WATER CHEMISTRY IN A NORTH CASCADES LAKE, Western Washington Univ., Bellingham. Inst. for

Watershed Studie

watersned Studies.
T. J. Loranger, and D. F. Brakke.
Water Resources Research WRERAO, Vol. 24,
No. 5, p 723-726, May 1988. 2 fig, 2 tab, 9 ref.

Descriptors: *Acid deposition, *Water chemistry, *Snowpack, *Snowmelt, *Lakes, *North Cascades Lake, Nitrates, Sulfates, Snow sampling, Chemical properties, Chemical analysis, Watersheds, Alka-linity, Hydrogen ion concentration.

Integrated snowpack samples and lakewater Washington state samples were collected from a low-alkalinity watershed in the North Cascades in 1984 and 1985 and analyzed for inorganic chemical paand 1965 and analyzed for morganic chemical parameters. Mean concentrations of NO3(-) and SO4(-) from a North Cascades snowpack were near 4.5 and 5.5 micro eq./L respectively. Mean pH was 5.2-5.3. During melting, anion levels in the snowpack decreased and pH increased. By July, mean NO3(-) and SO4(-) concentrations were 0.32 mean NO3(-) and SO4(-) concentrations were 0.32 and 1.73 micro eq/L, respectively, and mean pH was 5.48. Acid neutralizing capacity at the lake outlet during snowmelt was diluted to 50% of April premelt values. During snowmelt runoff there was no apparent neutralization of bicarbonate by strong acids. By comparing lakewater NO3(-) concentrations to snowpack concentrations, > 75% of the NO3(-) in the lake could be attributed to a snowpack source. An estimated 30% of the SO4(-) in the lake was derived from the snowpack. (Author's abstract)

FRESHWATER PHYTOPLANKTON IN THE LOW SALINITY REGION OF THE RIVER TAMAR ESTUARY, Southampton Univ. (England). Dept. of Oceanog-

raphy.

For primary bibliographic entry see Field 2L. W88-08721

TEMPORAL VARIATIONS OF SECONDARY PRODUCTION IN THE MARINE BIVALVE SPISULA SUBTRUNCATA OFF THE PORIVER DELTA (ITALY), Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. R. Ambrogi, and A. O. Ambrogi. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 3, p 369-379, September 1987. 8 fig. 2 tab. 32 ref.

tab. 32 ref.

Descriptors: *Productivity, *Secondary productivity, *Benthic fauna, *Mollusks, *Clams, *Rivers, *Deltas, Data collections, Benthos, Benthic environment, Annual distribution, Variability, Frequency analysis, Life history studies, Life cycles, Population dynamics, Growth rates, Mortality, Biomass, Marine environment, Sediments, Sand, Italy, Po River, Adriatic Sea.

As a part of a benthic monitoring program, size-frequency analysis was used to study the life history and production of a population of Spisula subtruncata inhabiting the sandy deposits of the Northern Adriatic Sea in front of the Po River delta. From grab samples collected quarterly at six stations from 1979 to 1984, all the individuals were measured. Growth and mortality rates were determined following cohorts through time; production was calculated as the sum of growth increments. The life cycle is mostly annual, recruitment occurring during the summer months, with only a few individuals surviving to the following summer.

The values of secondary production over the entire life cycle for each of the five cohorts studied ranged from 51.3 g/sq m to 580.6 g/sq m at 5-m deep stations, and from 14.3 g/sq m to 369.2 g/sq deep stations, and from 14.3 g/sq m to 599.2 g/sq m at 8-m deep stations. The production to mean biomass ratio calculated for the first year of life of the five cohorts ranged from 2.70 to 3.76 at 5 m and from 2.64 to 7.43 at 8 m. The only abiotic factor dearly responsible for the success of settling mentor treating responsible for the success of settling and maintaining the population of S. subtruncata is the percentage of sand in the sediment. The higher the percentage of sand, the more successful the recruitment. (Shidler-PTT)

W88-08726

SOURCES AND TRANSPORT OF PARTICU-LATE ORGANIC CARBON IN THE AMAZON RIVER AND ESTUARY,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans. For primary bibliographic entry see Field 2L.

FISH FAUNA OF LAKE MAUREPAS, AN OLI-GOHALINE PART OF THE LAKE PONT-CHARTRAIN ESTUARY,

Southeastern Louisiana Univ., Hammond. Dept. of Biological Sciences. For primary bibliographic entry see Field 2L. W88-08751

RADIOCHEMICAL ANALYSIS OF PHOSPHO-RUS EXCHANGE KINETICS BETWEEN SEDI-MENTS AND WATER UNDER AEROBIC CON-

Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering. For primary bibliographic entry see Field 5B.

MIXING PROCESSES RELEVANT TO PHYTO-PLANKTON DYNAMICS IN LAKES,

Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.

R. H. Spigel, and J. Imberger. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 361-377, 1987. 3 fig, 1 tab, 98 ref.

Descriptors: *Lakes, *Phytoplankton, *Mixing, Water circulation, Stratification, Waves, Water temperature, Diurnal variation, Turbulence, Nutri-ents, Productivity, Light penetration, Wind effects, Energy dissipation, Kinetics, Algae, Eddy diffu-

Active turbulence in lakes is confined to the sur-face mixed layer, to boundary layers on the lake sides and bottom, and to turbulent patches in the interior. The density stratification present in most lakes fundamentally alters the pathways connecting external mechanical energy inputs, for exam-ple, but wind, with its ultimate fate as dissipation to heat; the density stratification supports internal waves and intrusions that distribute the input energy throughout the lake. Intrusions may viewed as internal waves with zero horizontal wavenumber and are formed each time localized mixing occurs in a stratified fluid. Intrusions are also formed in the epilimnion by differential heating or cooling and by differential deepening. The fraction of lake volume below the diurnal mixed layer that is subject to active turbulence is very small, probably of the order of 1% or less in small to medium-sized lakes. By contrast, in the surface mixed layer, turbulence is less intermittent and maintains phytoplankton in suspension and controls their exposure to the underwater solar flux. Nutrient transport to individual cells depends not only on the cell Reynolds number but also on the Peclet number, which, if large, implies enhanced mass transfer above purely diffusive values. (Author's abstract) W88-08765

Group 2H—Lakes

CYANOBACTERIAL DOMINANCE: THE ROLE OF BUOYANCY REGULATION IN DYNAMIC LAKE ENVIRONMENTS, Freshwater Biological Association, Windermere

Freshwater Diougnate (England), C. S. Reynolds, R. L. Oliver, and A. E. Walsby. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 379-390, 1987. 1 fig, 3 tab, 65 ref.

Descriptors: *Lakes, *Algae, *Phytoplankton, *Cyanophyta, *Buoyancy, Flotation, Mixing, Sedi-mentation, Nutrients, Population dynamics, Turbu-lence, Photosynthesis, Light penetration.

The interactions of size, shape, and density of cyanobacteria result in a 5-order of magnitude difference in flotation or sinking rates, which, in turn, influence the extent of their dispersion in turbulent water masses. Active mixing through resource-replete waters of high clarity favors fastrowing, small-celled species. Where photosynthetically active radiation is severely attenuated through the wind-mixed layer, species may rely on turbulent entrainment but must be adapted toward efficient light harvesting (morphological attenuation, enhanced pigmentation). In both strongly segregated waters (light- and nutrient-rich layers separated vertically) and waters experiencing high-frequency fluctuations in vertical mixing and optical depth, emphasis is placed on the ability to make rapid, buoyancy-adjusted vertical movements, favored by large size. The cyanobacteria life-forms respectively typical of these contrasted limnological systems-unicellular coccoids (e.g., Synechorespectively typical of these contrasted limnologi-cal systems-unicellular coccoids (e.g., Synecho-coccus), solitary filaments (e.g., Oscillatoria) and colonial forms (e.g., Microcystis)-illustrate the di-versity of evolutionary adaptations to be discerned among the planktonic cyanobacteria and which contributes to their reputation as a prominent and successful group of organisms. (Author's abstract) W88-08766

TEMPERATURE EFFECTS ON PHOTOSYN-THETIC CAPACITY, RESPIRATION, AND GROWTH RATES OF BLOOM-FORMING CYANOBACTERIA,

National Inst. for Water Research, Pretoria (South

National Africa).

R. D. Robarts, and T. Zohary.

New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 391-399, 1987. 3 fig, 3 tab, 52 ref.

Descriptors: *Lakes, *Literature reviews, *Algae, *Phytoplankton, *Photosynthesis, *Growth rates, *Cyanophyta, *Respiration, *Water temperature, Algal bloom, Diatoms, Anabaena, Aphanizomenon, Oscillatoria, Microcystis, Population dynamics, Temperature, Mixing, Nutrients, Hypertrophic lakes

The literature was reviewed to determine the direct temperature effects on photosynthetic ca-pacity, specific respiration rate, and growth rate of direct temperature effects on photosynthetic eapacity, specific respiration rate, and growth rate of
bloom-forming cyanobacteria (Anabaena, Aphanizomenon, Microcystis, Oscillatoria) and to assess
the importance of direct temperature effects on
cyanobacterial dominance in lakes. This analysis is
supported by field studies of Microcystis aeruginosa in a hypertrophic lake. The literature and field
data show that photosynthetic capacity, specific
respiration rate, and growth rate are temperaturedependent with optima usually at 25 C or greater.
The four genera varied in their response to low
temperatures, with Microcystis being most severely limited below about 15 C. Oscillatoria tended to
tolerate the widest range of temperatures. Howevtolerate the widest range of temperatures. However, an examination of field data from representative lakes around the world indicated that direct temperature effects were secondary to indirect temperature effects (mixing), and nutrients in determining the dominance of bloom-forming cyanobacteria in lakes. Direct temperature effects probably act synergistically with other factors in this process. (Author's abstract) W88-08767

LIGHT-DEPENDENCE OF PHOTOSYNTHE-SIS AND GROWTH IN CYANOBACTERIA: IM-PLICATIONS FOR THE DOMINANCE IN EU-TROPHIC LAKES.

Konstanz Univ. (Germany, F.R.). Limnological

Inst. M. M. Tilzer. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 401-412, 1987. 6 fig, 87 ref.

Descriptors: *Lakes, *Photosynthesis, *Algae, *Phytoplankton, *Light quality, *Cyanophyta, Growth rates, Eutrophic lakes, Respiration, Population_dynamics, Mixing, Pigments, Phycobilins,

In eutrophic lakes cyanobacteria are favored relative to other phytoplankton, both under stratified and mixed conditions. During stratification, gas vacuole formation allows the accumulation of dense surface scums which attain the highest possible area-specific photosynthetic rates in aquatic environments owing to high irradiances, near-complete harvesting of impinging light, and minimal light inhibition and photo-oxidation. During moderate mixing, high yields of biomass can be achieved by effective light harvesting for photosynthesis (aided by phycobilin pigments) and low maintenance energy requirements at low mean irradiances. However, nitrogen fixation competes for energy and reductant with photosynthesis, and leads to a decline of light-saturated maximum growth rates. Wind-driven vertical mixing and lateral advection are the main causes for the instability of cyanobacterial blooms in hypereutrophic lake ecosystems. (Author's abstract) lake ecosystems. (Author's abstract) W88-08768

MACRONUTRIENT CONTROLS ON NITROGEN FIXATION IN PLANKTONIC CYANO-BACTERIAL POPULATIONS,
California Univ., Berkeley. Dept. of Civil Engi-

neering. A. J. Horne, and M. L. Commins. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 413-423, 1987. 2 fig, 8 tab, 29 ref.

Descriptors: *Lakes, *Estuaries, *Eutrophication, *Nutrients, *Nitrogen fixation, *Phytoplankton, *Algae, *Cyanophyta, Population dynamics, Phosphorus, Enzymes, Iron, Nitrogenase.

Experiments described in the literature have dem-onstrated that additions of N, Fe, and occasionally P, influence planktonic cyanobacterial nitrogen fix-ation in lakes and estuaries throughout the world. Increase in abundance of cyanobacteria which can Increase in abundance of cyanobacteria which can fix nitrogen did not necessarily indicate that N2 fixation had occurred. In natural plankton assemblages, N2 fixation was normally stimulated by low total inorganic nitrogen and depressed by additions of total inorganic nitrogen. Nitrogenase was often stimulated by addition of Fe but soluble reactive phosphate alone only stimulated nitrogenase activity occasionally. Luxury consumption and storage phosphate alone only stimulated nitrogenase activity occasionally. Luxury consumption and storage of P, but not N, explains the lack of P stimulation in nature. Nitrogenase activity was usually repressed at total inorganic nitrogen concentrations of > 50-100 microgram/liter. Additions of N + P had variable effects which may depend on the balance between nitrogenase inhibition by N and general growth stimulation by N + P (which reduces ambient N). (Author's abstract) W88-08769

ROLE OF MACRONUTRIENTS (C, N, P) IN CONTROLLING CYANOBACTERIAL DOMINANCE IN TEMPERATE LAKES,

Ottawa Univ. (Ontario). Dept. of Biology. F. R. Pick, and D. R. S. Lean. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 425-434, 1987, 2 tab, 73 ref.

Descriptors: *Lakes, *Eutrophication, *Algae, *Phytoplankton, *Cyanobacteria, *Nutrients, Population dynamics, Carbon, Nitrogen, Phosphorus.

Cyanobacteria are the only group of phytoplank-ton to show a clear increase both in biomass and relative contribution to total phytoplankton biomass as temperate lakes become eutrophic. Correlative studies indicate that this increase begins at

total phytoplankton biomass levels of 3-5 mg fresh weight/liter or spring total phosphorus (TP) concentrations of 25-30 microgram/liter. Above (TN)TP ratios of 30, cyanobacteria tend to become rare, but below this value they may or may not dominate. Better predictions may be possible by attempting to remove the influence of the refractory dissolved organic nitrogen (DON) and phosphorus (DOP) fractions by using the TN-DON:TP-DOP ratio. While experimental manipulation of N:P ratios in enclosures or entire lakes may often stimulate or suppress relative evanobacteria. nation of Ner ratios in encourses of entire takes may often stimulate or suppress relative cyanobacterial biomass, laboratory studies do not clearly link low NP. Pratios with cyanobacteria. Evidence from correlative studies, long-term records of indirrom correlative studies, long-term records of motivational lakes, and experimental manipulations of nutrient loads suggest that other factors such as temperature, mixing regimes, transparency, and iron or carbon availability may influence cyanobacterial dominance in lakes. (Author's abstract)

MICRONUTRIENT EFFECTS ON CYANOBAC-TERIAL GROWTH AND PHYSIOLOGY,

Portland State Univ., OR. Dept. of Biology.
J. G. Reuter, and R. R. Petersen.
New Zealand Journal of Marine and Freshwater
Research NZJMBS, Vol. 21, No. 3, p 435-445,
1987. 4 fig. 78 ref. National Science Foundation
Grant OCE 83-16093.

Descriptors: *Lakes, *Nutrients, *Algae, *Phytoplankton, *Cyanophyta, *Heavy metals, Growth rates, Metals, Copper, Iron, Molybdenum, Manganese, Photosynthesis, Trace elements, Nitrogen fixation, Carbon, Toxicity, Population dynamics, Productivity, Primary productivity.

Trace metals play crucial roles in the carbon and nitrogen metabolism of cyanobacteria. Physiologi-cal responses to metal limitations and toxicity in culture have shown that iron is important for photosynthesis and energy distribution in the cell while both iron and molybdenum are biochemically involved in nitrate reduction and nitrogen fixaly involved in nitrate reduction and nitrogen fixa-tion. Nitrogen fixation is also relatively sensitive to copper toxicity. Consequently, factors that affect the supply rate, chemical speciation, or the recy-cling of trace metals can alter patterns of primary productivity and nitrogen metabolism. Overall, three trace metal dependent processes may contrib-ute towards dominance: efficient use of limiting light, nitrogen fixation, and production of extracel-lular iron binding compounds. (Author's abstract) W88-0871

CYANOBACTERIAL AMMONIUM TRANS-PORT, AMMONIUM ASSIMILATION, AND NITROGENASE REGULATION,

Dundee Univ. (Scotland). Dept. of Biological Sci-

ences. N. W. Kerby, P. Rowell, and W. D. P. Stewart. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 447-455, 1987. 4 fig, 2 tab, 66 ref.

Descriptors: *Lakes, *Phytoplankton, *Algae, *Cyanophyta, *Ammonium, *Nitrogen, Respiration, Enzymes, Growth rates, Nutrients, Methylammonium, Ethylenediamine, Respiration, Nitro-

The growth of cyanobacteria in natural waters may be dependent on an efficient ammonium transport system. Such a system may also play a role in the retention of internally generated ammonium from N2 fixation, nitrate reduction, and photorespiration. Methylammonium is commonly used as spiration. Methylammonium is commonly used as an ammonium analogue to study transport. The kinetics of methylammonium uptake by cyanobacteria are biphasic with a first rapid phase representing transport into the cells and a second slower phase dependent on metabolism by the primary ammonia assimilating enzyme glutamine synthease. At high external pH values (pH>9) diffusion of the uncharged species becomes increasingly dominant while at neutral pH values the uptake is thought to be an active process dependent on membrane potential. (Author's abstract) W88-08772

Lakes-Group 2H

FIELD STUDIES ON ZOOPLANKTON-CYAN-OBACTERIA INTERACTIONS, New Hampshire Univ., Durham. Dept. of Zoolo-

By.
J. F. Haney.
J. F. Haney.
New Zealand Journal of Marine and Freshwater
Research NZJMBS, Vol. 21, No. 3, p 467-475,

Descriptors: *Eutrophication, *Lakes, *Zooplankton, *Phytoplankton, *Algae, *Cyanophyta, Eutrophic lakes, Grazing, Algal blooms, Cladocerans, Copepods, Daphnia, Microcystis, Anabaena, Aphanizomenon.

Aphanizomenon.

Correlative field evidence suggests that large grazers such as Daphnia pulex promote the growth of colonial cyanobacteria by selectively eating competitive phytoplankton. This is supported by experimental evidence that (1) in eutrophic lakes dominated by cyanobacteria grazing by zooplankton on small particles is often > 100% per day, and (2) colonial cyanobacteria are generally not grazed as rapidly as smaller phytoplankton. Cyanobacteria generally have deleterious effects on grazing zooplankton. Filamentous cyanobacteria such as Anabena and Oscillatoria can inhibit filtering by cladocerans, reducing growth and reproduction. Detrimental effects on zooplankton via nutritional deficiencies and toxins of cyanobacteria have been demonstrated in the laboratory but not in the field. Grazing on colonial cyanobacteria by zooplankton appears to be an important trophic link in tropical lakes. Generally, calanoid copepods seem best adapted to utilizing large cyanobacteria. The generalization that, with increasing eutrophication, zooplankton communities tend to shift from a dominance of calanoid copepods to cladocerans, does not apply to lakes in New Zealand. (Author's abstract)

INSIGHTS INTO ZOOPLANKTON-CYANO-BACTERIA INTERACTIONS DERIVED FROM ENCLOSURE STUDIES,

Otago Univ., Dunedin (New Zealand). Dept. of Zoology. Zoology. C. W. Burns.

New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 4747-482, 1987. 2 fig, 1 tab, 28 ref.

Descriptors: *Lakes, *Zooplankton, *Phytoplankton, *Algae, *Cyanophyta, Grazing, Population dynamics, Ammonia, Anabaena, Aphanizomenon, Microcystis, Daphnia, Nitrogen fixation, Phohphorus, Silicon.

Few workers have used enclosures specifically to study interactions between zooplankton and cyan-obacteria. Differences among studies in enclosure size, nutrient level, plankton abundance and species composition, presence or absence of fish, and length of experiments make generalizations diffi-cult. Zooplankton had no direct effect on the growth of ungrazed evapolacteria (Anphaena florlength of experiments make generalizations diffi-cult. Zooplankton had no direct effect on the growth of ungrazed cyanobacteria (Anabaena flos-aquae, Aphanizomenon flos-aquae, large Microcys-tis colonies) in short-term (<5 days) and long-term (>1 month) enclosure studies. When large cyano-bacteria were abundant, some Daphnia spp. showed reduced reproduction and development. When large grazers were abundant, they sup-pressed the growth of edible, colonial cyanobac-teria (Aphanizomenon elenkinee, small Microcystis colonies). By altering the ambient light and nutri-ent environment, large zooplankton may suppress cyanobacteria; evidence for the importance of grazers in promoting cyanobacterial dominance by removing competing phytoplankton species is grazers in promoting cyanobacterial dominance by removing competing phytoplankton species is equivocal. Zooplankton may suppress nitrogen fixation by cyanobacteria through ammonia excretion and may promote a change in dominance from diatoms to cyanobacteria through recycling phosphorus but not silicon. (Author's abstract) W88-08774

LABORATORY STUDIES ON ZOOPLANK-TON-CYANOBACTERIA INTERACTIONS, Max-Planck-Inst. fuer Limnologie zu Ploen (Ger-many, F.R.). Dept. of Ecophysiology. W. Lampert.

New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 483-490,

Descriptors: *Lakes, *Food chains, *Zooplankton, *Phytoplankton, *Algae, *Cyanophyta, Grazing, Algal blooms, Cladocerans, Copepods, Microcystis, Anabaena, Aphanizomenon, Rotifers, Growth rates, Toxins, Daphnia.

Laboratory studies on cyanobacteria-zooplankton interactions have largely focused on the inadequacy of cyanobacteria as a food source. Some features of cyanobacteria can be regarded as antierbivore defenses. Large colonies of Aphanizomenon, Anabaena, and Microcystis cannot be handled by contracted to the contract of menon, Anabaena, and Microcystis cannot be handled by zooplankton, but do not interfere seriously with the filtering process. Small colonies and filaments, however, may cause severe inhibition of the feeding process by mechanical interference. This reduces zooplankton growth, reproduction, and survival. Copepods, rotifers, and Bosmina are less affected by mechanical disturbance than cladocerans. If ingested, some cyanobacteria may be poorly digested or may not provide essential nutrients. Some cyanobacteria are reported to be toxic to zooplankton. Several strains of Microcystis. Produce an endotoxin, but the amount of toxin produced differs among strains and with the condition of Microcystis. Zooplankton encountering toxic cells cease feeding. Some evidence of an extra-cellular herbivore deterrent was found for Anabaena. Thus, cyanobacteria may either be indi-Anabaena. Thus, cyanobacteria may either be indi-vidually protected or may create an environment that is unfavorable for efficient grazers. (Author's W88-08775

PLANKTONIC CYANOBACTERIA IN NEW ZEALAND INLAND WATERS: DISTRIBUTION AND POPULATION DYNAMICS,

Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre. R. D. Pridmore, and M. K. Etherege.

New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 491-502, 1987. 2 fig, 6 tab, 77 ref, append.

Descriptors: *Lakes, *Literature reviews, *Phyto-plankton, *Algae, *Species composition, *Species distribution, *Cyanophyta, Glacial lakes, Popula-tion dynamics, Algal blooms, New Zealand,

One hundred and four taxa of planktonic cyano-bacteria have been recorded from New Zealand bacteria have been recorded from New Zealand lakes: 32 belong to the Chrococcales, 72 to the Nostocales. None of the taxa is endemic to New Zealand; most (if not all) are cosmopolitan. On average, more taxa have been reported from North Island (7.8 + or - 6.7, N = 69) than South Island lakes (3.3 + or - 3.9, N = 59). This difference is attributable, in part, to the large proportion of glacial lakes in the South Island, which are commonly poor in plant nutrients and possess sparse phytoplankton populations. Many of the taxa show a strong preference for eutrophic conditions. Notaphytoplankton populations. Many of the taxa show a strong preference for eutrophic conditions. Notable exceptions are Anabaena affinis and Gomphosphaeria lacustris, which occur in a large proportion of mesotrophic (48%) and oligotrophic lakes (43%), respectively. Taxa which are often abundant and frequently responsible for conspicuous water blooms are Microcystis aeruginosa, Anabaena circinalis, A flos-aquae, and A. spiroides. The limited population data available indicate a high level of interannual variability in the timing, magnitude, and duration of cyanobacterial blooms in New Zealand lakes. (Author's abstract) W88-08776

CYANOBACTERIA IN NEW ZEALAND INLAND WATERS: EXPERIMENTAL STUD-

Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab. A. B. Viner.

New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 503-507,

Descriptors: *Lakes, *Algae, *Phytoplankton, *Cyanophyta, New Zealand, Nitrogen fixation, Photosynthesis.

Research on cyanobacteria in New Zealand during the past 20 years has been restricted to a few workers and sparsely spread through diverse topics. Available information is generally oriented toward fixation of nitrogen in various habitats and growth conditions leading to cyanobacterial species dominance. Symbiotic relationships with respect to nitrogen fixation exist between Nostoc and Gunnera and between Anabaena and Azolla. The rate of nitrogen fixation by benthic cyanobacteria (Nostoc, Calothrix, Anabaena) declines away from the water's edge. Oxygen inhibition of nitrogen fixation is attributable to photorespiration, with these processes competing for a common metabolic product of photosynthesis. Studies have also been concerned with the effects of nutrients, light, temperature, biotic interactions, and toxic substances Research on cyanobacteria in New Zealand during perature, biotic interactions, and toxic substances (boron in geothermal waters and naturally pro-duced toxins from plants). (Cassar-PTT)

CIRCULATION AND MIXING IN LAKE RO-TONGAIO AND LAKE OKARO UNDER CON-DITIONS OF LIGHT TO MODERATE WINDS: PRELIMINARY RESULTS. Western Australia Univ., Nedlands. Centre for

Water Research.

New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 515-519, 1987. 3 fig. 3 ref.

Descriptors: *Lakes, *Measuring instruments, *Phytoplankton, *Algae, *Cyanophyta, *Water circulation, *Mixing, *Wind effects, Lake Rotton-gaio, Lake Okaro, New Zealand, Population dy-namics, Algal blooms, Temperature, Water tem-perature, Air temperature.

Circulation and mixing were studied in Lake Ro-Circulation and mixing were studied in Lake Ro-tongaio using temperature gradient microstructure profiling instruments, drogues, and an automatic weather station capable of measuring incoming solar radiation, wind speed and direction, air tem-perature and relative humidity at 10-min intervals. Inflows, outflows, and inflow plunging characteris-tics were documented with dye releases. Sufficient data were gathered on Lake Rotongaio to docu-ment the dynamics of the mixed laws as wellthat were gameted on Lake Rottongaio to docu-ment the dynamics of the mixed layer as well as the mixing internally and at the boundaries. A surprising finding in Lake Rottongaio was the almost total absence of turbulence in the lake almost total absence of turbulence in the lake below the diurnal thermocline. Temperature differ-ences of as little as I C (caused by shelter or shade) were capable of driving strong horizontal circula-tions, resulting in exchange of littoral water with the main body of the lake. The greater water clarity of Lake Okaro permitted solar radiation of penetrate several meters so that the extreme stabili-ty found in the top meter of Lake Rotongaio did of occur in Okaro. In addition, turbulent patches of water were found; this was caused by the complete bottom topography of Okaro. It was shown that the inflow intrusion was critically dependent on the wind mixing at the plunge point. (Cassar-W88-08778

BUOYANCY REGULATION BY MICROCYS-TIS IN LAKE OKARO,

AIS IN LARE UKARU, Bristol Univ. (England). Dept. of Botany. A. E. Walsby, and G. K. McAllister. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 521-524, 1987. 5 ref.

Descriptors: *Lakes, *Phytoplankton, *Algae, *Cyanophyta, *Buoyancy, *Mixing, Water circulation, Microcystis, Lake Okaro, New Zealand, Flotation, Vertical distribution.

Microcystis colonies in Lake Okaro exhibited fast floating velocities, up to 1 mm/sec; after gas va-cuole collapse the colonies sank at over 3 mm/sec. The average sinking velocity of the colonies after 11 hours of additional illumination, 52 m/day, was

Group 2H-Lakes

sufficient to allow a migration to the lake bottom (mostly < 18 ft deep) in 8 hours or to the seasonal thermocline (at about 7 m) in less than 4 hours. The flotation rate of 49 m/day of colonies kept in The flotation rate of 49 m/day of colonies kept in darkness would allow return to the lake surface in about the same time. These properties were related to the physical characteristics of Lake Okaro: Secchi disc depth, 2.7 m; euphotic depth, 4.5 m; very slight thermal density gradient; mixing to the bottom of the euphotic zone during periodic windy periods. During calm periods Microcystis can sink down several meters to avoid potentially inhibiting irradiances. During during mixing events the colonies of turn accept meters to avoid potentially limbting irradiances. During diffurnal mixing events the colo-nies are circulated within the euphotic zone, would experience low mean irradiation averaged over time, and would probably become or remain buoy-ant, ready to float up when mixing ceased. (Cassar-

ROLE OF BUOYANCY IN THE DISTRIBU-TION OF ANABAENA SP. IN LAKE ROTON-GAIO.

GAIO,
Bristol Univ. (England). Dept. of Botany.
A. E. Walsby, C. S. Reynolds, R. L. Oliver, J.
Kromkamp, and M. M. Gibbs.
New Zealand Journal of Marine and Freshwater.
Research NZJMBS, Vol. 21, No. 3, p 525-526, 1987. 4 ref.

Descriptors: *Lakes, *Phytoplankton, *Algae, *Cyanophyta, *Buoyancy, Anabaena, Lake Rotongaio, New Zealand, Flotation, Vertical distribution.

The species of Anabaena that dominated the phy-toplankton community of Lake Rotongaio during February and March 1987 was a non-colonial, fila-February and March 1987 was a non-colonial, filamentous organism made buoyant by gas vacuoles. Low flotation velocities (0.1 to 0.4 m/day) were attributed to four possible factors: (1) The growth rate of filaments nearer the surface would have been greater than those at a depth. (2) Water flowing in from a stream spread into the lake at a depth of about 4.5 m and created an upwelling of 0.1 m/day. (3) The upward floating velocity of the filaments themselves was similar. (4) Grazing of filaments at the lower depths affected the vertical distribution. (Cassar-PTT) distribution. (Cassar-PTT) W88-08780

CARBOHYDRATE-TO-PROTEIN RATIO AS A BIOLOGICAL INDICATOR OF WATER MOVEMENT.

MULTIANDALINE Freshwater Research Centre, Albury (Australia).
R. L. Oliver, and J. C. Kromkamp.
New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 529-530, 1987. 1 fig, 2 tab, 2 ref.

Descriptors: *Lakes, *Phytoplankton, *Algae, *Cyanophyta, *Buoyancy, Flotation, Vertical distribution, Lake Rotongaio, New Zealand, Carbohydrates, Proteins

The vertical and horizontal variation in the The vertical and horizontal variation in the carbohydrate:protein ratio of the phytoplankton reflected the circulation pattern in Lake Rotongaio. Cells contained within the surface downwind current showed an increase in the ratio as expected from the increased illumination time with distance. Conversely, cells in the return current at depth showed a reduced ratio due to increasing time in the dark. (Cassar-PTT)

EFFECTS OF CHANGES IN BOTH THE ABUNDANCE OF NITROGEN AND PHOSPHORUS AND THEIR RATIO ON LAKE OKARO PHYTOPLANKTON WITH COMMENT ON SIX OTHER CENTRAL VOLCANIC PLATEAU LAKES.

National Water Research Inst., Burlington (Ontar-

10). D. R. S. Lean, S. F. Mitchell, F. R. Pick, J. G. Reuter, and M. T. Downes. New Zealand Journal of Marine and Freshwater Research NZJMBS, Vol. 21, No. 3, p 539-542, 1987. 1 tab, 2 ref.

Descriptors: *Lakes, *Phytoplankton, *Algae, *Cyanophyta, *Nutrients, Lake Okaro, New Zead, Nitrogen, Phosphorus, Nutrients, Iron.

The effects of various nutrient regimes (Fe, P, and N, singly and in combination) on cyanobacteria populations were tested in 960-liter enclosures in Lake Okaro. The only enclosures to respond with a chlorophyll a increase were those to which N was added. Where P was also added, chlorophyll a production proceeded more quickly for several days, producing an 8-fold increase by the tenth day. The addition of phosphate reduced the biomass of green algae, so that the relative importance of Microcystis increased slightly. The addition of pricets and aftests also a hopeshets timelated. of Microcystis increased signity. In a adultion of intrate and nitrate plus phosphate stimulated green algae so that they comprised 80% of the biomass. Microcystis increased numerically under the nitrate plus phosphate treatment, but it remained List to the total by the tenth day. Nitrogenfixing cyanobacteria were never a significant comnxing cyanobacteria were never a significant com-ponent under any nutrient treatment. Surveys of seven lakes indicated nitrogen deficiency in all lakes; extreme phosphorus deficiency in Okareka, Okaro, and Rotoaira; low P deficiency in Rotorua, Tarawera, and Ngahewa; and no P deficiency in Rotongaio. (Cassar-PTT) W88-08782

EFFECT OF SILTATION ON STREAM FISH COMMUNITIES, Missouri Univ., Columbia. School of Forestry. For primary bibliographic entry see Field 2J. W88-08784

MODEL FOR ACID AND ALKALINE PHOS-PHATASE ACTIVITY IN A SMALL POND, Warwick Univ., Coventry (England). Dept. of Enwarwing City vironmental Sciences. M. Matavulj, and K. P. Flint. Microbial Ecology MCBEBU, Vol. 13, No. 2, p 141-158, 1987. 4 fig, 3 tab, 42 ref.

Descriptors: *Algae, *Eutrophication, *Model studies, *Ponds, *Phytoplankton, Enzymes, Regression analysis, Phosphatase, Alkaline phosphatase, Acid phosphatase.

Acid and alkaline phosphatase activity were determined in a small pond over a period of 24 months (64 samples). Activity of each phosphatase enzyme was positively correlated with chlorophyll concentration, viable bacterial count, total phosphate contration, viable bacterial count, total phosphate concentration, inorganic phosphate concentration, inorganic phosphate concentration, and temperature. Multiple regression analysis was used to formulate equations that described phosphatase activity in terms of these physical, chemical, and biotic factors. Corrected coefficients of determination were calculated, and the highest values were obtained when all parameters were included in the equation r squared = 0.776 and 0.659 for alkaline and acid phosphatase activity, respectively). However, there was little improvement in the r squared value obtained when only chlorophyll was used in the equation r squared = 0.654 and 0.624, respectively). Samples were then taken over a further 12 months (25 samples), and observed activity was compared with the activity predicted by application of previously derived equations. For alkaline phosphatase, the best fit between observed and expected activity was seen with the equation conphosphatase, the best it between observed and expected activity was seen with the equation containing all parameters, but for acid phosphatase the best fit was seen with the equation containing only chlorophyll and temperature as the determinants. In both cases there was a good fit between observed and expected data using the equation containing chlorophyll as the sole determinant. From this was have concluded that abuvelengter, were this we have concluded that phytoplankton were the chief producers of phosphatase activity in this pond, although the influence of physical and chem-ical factors on enzyme activity could not be ignored. (Author's abstract) W88-08786

NEGATIVE STAINING OF FRESHWATER BACTERIONEUSTON SAMPLED DIRECTLY WITH ELECTRON MICROSCOPE SPECIMEN

SUPPORT GRIDS,
Queensland Univ., Brisbane (Australia). Dept. of
Microbiology.

For primary bibliographic entry see Field 7B. W88-08788

KINETICS OF ALKALINE PHOSPHATASE ACTIVITY AND PHOSPHORUS AVAILABILITY FOR PHYTOPLANKTON AND BACTERIO-PLANKTON IN LAKE PLUSSSEE (NORTH GERMAN EUTROPHIC LAKE),

Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie. R. J. Chrost, and J. Overbeck. Microbial Ecology MCBEBU, Vol. 13, No. 3, p 229-248, 1987, 8 fig. 3 tab, 46 ref.

Descriptors: *Lakes, *Nutrients cycles, *Plankton, *Phytoplankton, *Eutrophication, *Kinetics, *Phosphorus, *Lake Plusssee, *Germany, *Algae, Bacterioplankton, Alkaline phosphatase.

Annual studies of kinetics of alkaline phosphatase (APA) activity and phosphorus availability for microplankton in the photic zone of an eutrophic lake are reported. The total APA activity of microplankton varied strongly. V sub max was highest during summer P depletion, and in autumn and winter total APA activity was low. The total APA seccific activity of the microplankton was also winter total APA activity was low. The total APA specific activity of the microplankton was also highest when ambient orthophosphate concentrations were very low. Both V sub max and specific APA activity were not dependent on the biomass of microplankton, they were strongly affected by Pavailable for microplankton. A differential filtration technique was used for separation of microplankton was used for separation of microplankton. tion technique was used for separation of microplankton into two size classes: (1) algal, larger than 3 microns, and (2) bacterial, from 0.2-3.0 microns. The algal size fraction had lower specific APA activity and higher K sub M values than microorganisms which were smaller than 3 microns. The K sub m values of free, dissolved APA indicated that free APA was probably released by algae. Phytoplankton were major APa activity producers in the photic zone of the lake from March to November, and their activity constituted on the average 48.6% of the total APA activity in the water. Bacteria were the dominant APA activity producers in winter, however, during other periwater. Bacteria were the dominant APA activity producers in winter; however, during other periods they contributed significantly to total APA activity. When surplus P constituted less than 10% of particulate P in seston, phytoplankton produced high specific APA activity, and when surplus P was higher than 15%, the specific activity of phytoplankton size fraction rapidly decreased. APA of the bacterial size fraction of the seston was not affected by P concentrations. Critophosphate was the bacterial size fraction of the seston was not affected by P concentrations. Orthophosphate was a competitive inhibitor of APA produced by microorganisms of the size fraction larger than 3.0 micrometers, and increasing concentrations of inorganic phosphate caused an increase in K sub m values. The hypothetical metabolic-coupling between phytoplankton and bacterioplankton in the phosphorus cycle in conjunction with carbon matabolism in the lake is discussed. (Author's abstract) W88-08789

SEASONAL SUCCESSION OF A MICROPHA-GOTROPH COMMUNITY IN A SMALL POND DURING LITTER DECOMPOSITION,

Tokyo Metropolitan Univ. (Japan). Dept. of Biol-

H. Kusano, T. Kusano, and Y. Watanabe. Microbial Ecology MCBEBU, Vol. 14, No. 1, p 55-66, 1987. 8 fig. 3 tab, 16 ref.

Descriptors: *Lentic environment, *Ecosystems, *Succession, *Ponds, *Decomposition, *Bacteria, *Litter, *Detritus, Principal COmponent Analysis, Microphagotroph, Ecology, Species composition, Population dynamics.

Temporal dynamics of a lentic microphagotroph community were studied during leaf litter decomposition from December to May. Small plastic vessels containing leaf litter were placed on the pond bottom. They were sampled periodically to collect microphagotrophs. Three abiotic factors and abundance of food items were measured to enables the extremel and allowed to the properties of the extremely and allowed to the content of the extremely and the extremel analyze the autogenic and allogenic phenomena during a microphagotroph succession. The behav-ior types were recognized in dominant taxa: a free-

Lakes-Group 2H

swimming type, a vägile (creeps on substratum, sometimes swims) type, and a voluntarily fixed type. Dominant taxa changed from the free-swimning to the vagile type up to mid-March, and the reverse change occurred from mid-April. Principal component analysis (PCA) indicated four factors affecting the dynamics of the community: water temperature as a seasonal factor, detritus volume on the litter surface as a habitat factor, and densities of bacteria and small flagellates as food factors. ties of bacteria and small flagellates as food factors. Taxa replacement appeared to occur through two mechanisms. (1) Dominance of small holotrichs, a free-swimming type, was brought about by a high bacterial density caused by seasonal events, (i.e., leaf fall in December and detritus formation by litter feeders in mid-April. This is an allogenic aspect of community dynamics. (2) The free-swimming type was replaced by the vagile one during the period with high taxa diversity. This replacement occurred through intertaxa competition for scarce food and/or selective predation by larger scarce food and/or selective predation by larger microphagotrophs. It is an autogenic process within the community. (Author's abstract)

POTENTIAL RATES OF NITRIFICATION AND DENITRIFICATION IN AN OLIGOTROPHIC FRESHWATER SEDIMENT SYSTEM,

Oregon Univ., Eugene. Dept. of Biology.
W. K. Dodd, and R. D. Jones.
Microbial Ecology MCBEBU, Vol. 14, No. 1, p
91-100, 1987. 3 fig. 2 tab, 31 ref. NSF Grants OCE8410145 and BSR-8408179.

Descriptors: *Nitrification, *Denitrification, *Nitrogen cycle, *Oligotrophy, Sediments, Acetylene blockage, Cold spring, Chemical reactions.

Potential rates of nitrification and denitrification were measured in an oligotrophic sediment system (a pool fed by cold spring water). Nitrification potential was estimated using the CO oxidation was measured by the acetylene blockage technique. The sediments demonstrated both nitrifying activity. E sub h, O2, and organic C profiles showed two distinct types of sediment. One type was low in organic C, had high O2 and E sub h, and had rates of denitrification 1000 times lower than the other which had high organic C, low O2, and low E sub h. Potential nitrification and denitrification rates were negatively correlated with E sub h. This suggests that environmental heterogeneity in denitrifier and nitrification and denitrification between denitrification and nitrification and ofenitrification between denitrification and nitrification and official on the control of these processes and NH4(+) or NO3(-) concentrations. The maximum rate of denitrification was 0.969 nmole N/cu cm hour, and the maximum rate of nitrification was 23.6 mole/cu cm hour, suggesting nitrification hour, and the maximum rate of nitrification was 23.6 nmole/cu cm hour, suggesting nitrification does not limit denitrification in these oligotrophic sediments. Some sediment cores had mean concentrations of 6.0 mg O2/liter and still showed both nitrification and denitrification activity. (Author's abstract) W88-08794

DYNAMICS OF MICROBIAL BIOMASS AND ACTIVITY IN FIVE HABITATS OF THE OKE-FENOKEE SWAMP ECOSYSTEM, Georgia Univ., Athens. Inst. of Ecology.

M. A. Moran, A. E. Maccubbin, R. Benner, and R.

Microbial Ecology MCBEBU, Vol. 14, No. 3, p 203-217, 1987. 6 fig, 3 tab, 38 ref. NSF Grants BSR 81-14823 and BSR 82-15587.

Descriptors: *Biomass, *Okefenokee Swamp, *Georgia, *Swamps, *Wetlands, *Ecosystems, *Microbiological studies, *Bacteria, Dynamics, Spatial distribution.

A variety of freshwater marsh and swamp habitats are found interspersed in a mosaic pattern through-out the Okefenokee Swamp, Georgia. We exam-ined spatial and temporal patterns in standing stocks and activity on the microbial community of five habitats within this heterogenous ecosystem. Standing stock dynamics were studied by measuring microbial biomass (ATP) and bacterial numbers (AODC) in both water and sediments over a 14 month period. Abundance varied temporally, being generally lower in winter months than in spring and summer months. However, a large proporties of the measured variability. spring and summer months. However, a large proportion of the measured variability was not correlated with temporal patterns in temperature or with bulk nutrient levels. Spatial variability was characteristic of the Okefenokee at a variety of large and small scales. Habitat-level heterogeneity was evident when microbial standing stocks and activity (measured as C-14 lignocellulose mineralization) were compared across five communities, although abundance differences among sites were although abundance differences among sites were restricted to nonwinter months when microbial biomass was high. Spatial variation within habitats was also found; patches of surface sediment with differing microbial activity or abundance were measured at scales from 30 cm to 150 m. (Author's abstract) W88-08796

COMMUNITY STRUCTURE OF SESSILE HE-TEROTROPHIC BACTERIA STRESSED BY ACID MINE DRAINAGE, Virginia Univ., Charlottesville. Dept. of Environ-mental Sciences.

For primary bibliographic entry see Field 5C. W88-08797

GROWTH CHARACTERISTICS OF SMALL AND LARGE FREE-LIVING AND ATTACHED BACTERIA IN LAKE CONSTANCE,

Konstanz Univ. (Germany, F.R.). Limnological

Microbial Ecology MCBEBU, Vol. 15, No. 2, p 151-163, 1988. 2 fig. 5 tab, 40 ref. Deutsche Fors-chungsgemeinschaft Grant Ti 115/3 and Ti 115/ 10-2.

Descriptors: *Lakes, *Lentic environment, *Bacteria, *Lake Constance, *Biomass, *Ecosystems, *Limnology, Germany, Growth, Free-living bacteria, Attached bacteria, Biomass turnover time.

The growth characteristics of small (0.2-1.0 micron) and large (1.0-3.0 micron) free-living and attached bacteria were studied in Lake Constance stractical discreta were studied in Lake Constance by comparing the spatial and seasonal dynamics of their biomass turnover time (ratio of biomass/production). The biomass of small free-living bacteria usually turned over significantly faster than that of large free-living bacteria throughout the water column. The turnover of attached bacterial biocolumn. The turnover of attached bacterial bio-mass was characterized by large fluctuations. Oc-casionally, in aphotic water layers, it was as long as that of large free-living bacteria, but when large amounts of decaying organic particles were present, it was shorter than that of small free-living cells. Biomass turnover times of free-living bacteria cells. Biomass turnover times of free-living bacteria were in the same range as their generation times, which were estimated from the increase in bacterial abundance in 3 micron prefiltered samples. The biomass turnover time of actively metabolizing bacteria was comparable to the generation time of actively metabolizing cells. These results indicate that the biomass turnover time is a useful indicator of the growth of different bacterial fractions, as it reflects their different amounts of participation in microbial processes of squartic geosystems. (Aumicrobial processes of aquatic ecosystems. (Au-thor's abstract) W88-08804

ECOLOGY OF VIBRIO CHOLERAE IN THE FRESHWATER ENVIRONS OF CALCUTTA,

INDIA,
National Inst. of Cholera and Enteric Diseases,
Calcutta (India).
For primary bibliographic entry see Field 5B.
W88-08805

DIFFERENCES IN PLATING EFFICIENCY OF BACTERIA FROM RIVER EPILITHON SAM-PLED FROM UPPER AND LOWER SURFACES OF ARTIFICIAL SUBSTRATA,

Tokyo Univ. of Agriculture and Technology (Japan). Lab. of Biology.

K. Morikawa. Microbial Ecology MCBEBU, Vol. 15, No. 2, p 217-228, 1988. 3 fig, 2 tab, 19 ref.

Descriptors: *Stream biota, *Culture media, *Epi-phytes, *Rivers, *Substrates, *Bacteria, *Microbio-logical studies, Tokyo, Tamagawa River, Agars,

The bacterial generic composition of biofilms was investigated by determining colony-forming units on 1/2 PYG (peptone, yeast extract, and glucose medium) agar plates. The biofilms developed on the upper and lower surfaces of artificial substrata submerged in river water at Unazuwa in the Tamagawa River in Tokyo, Japan. Greater variation in the number and generic composition in platable colonies was obtained on the upper surface of an artificial substratum than on the lower surface. This variation corresponded to the variation in colonies was ordinated on the upper surface of an artificial substratum than on the lower surface. This variation corresponded to the variation in algal biomass. Accompanying the growth of the algae, specific bacteria commensal with the algal proliferated on the upper surface. The biofilm exfoliated when the surface density of chlorophyll was 11.2 micrograms per sq. cm. When the biofilm exfoliated, the bacterial composition altered. The bacterial composition after exfoliation resembled that observed on the lower surface. The generic composition on the upper surface soon after it was initially submerged resembles that observed in the river water. The bacterial generic composition on the lower surface of the artificial substrata did not change greatly throughout the investigation because of the constant environmental conditions. The differences between the bacterial composition on the upper and lower surfaces was due to the on the upper and lower surfaces was due to the fact that bacteria commensal with algae proliferat-ed on the upper surface but not on the lower. (Author's abstract) W88-08806

CHEMICAL CHARACTERISTICS OF THE WATER IN THE RICEFIELDS OF THE EBRO DELTA (N.E. SPAIN),

Barcelona Univ. (Spain). Dept. de Ecologia. E. Fores, and F. A. Comin. Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 1, p 15-24, November 1987. 9 fig, 1 tab, 15 ref.

Descriptors: "Phosphorus, "Nitrogen, "Limnology, "Ricefields, Total reactive phosphorus, Dissolved inorganic nitrogen, Seasonal variation, Ebro Delta, Spain, Ecoaystems.

The seasonal changes of some limnological parameters were studied in a paddy field in the Delta of the Ebro River. Two phases are distinguished during the period of the rice cultivation. The first one, from the start of the flooding until July, is characterized by relatively high values of dissolved oxygen (7-12 mg/l) and pH (8-9.3) and Down values of alkalinity (0.95-2 mgc/l) together with a poor development of plant populations. The second phase goes from July to the harvest, in early October. Low dissolved oxygen (1.74.7 mg/l) together with a dense macrophytic vegetation and considerable height of the rice plants over the water surface characterize this phase. A third phase, from October to February, can be considered in some ricefields flooded again after harvesting for waterfowl hunting. Lack of vegetation, decreasing temperature and pH, alkalinity and dissolved oxygen values intermediate between those of the two previous phases characterize the water. These results show the significant contrasts of the ecosystem metabolism between conditions of veryence and extre hological populations and others ecosystem metabolism between conditions of very dense and active biological populations and others when physical factors and human activities exert a strong control of chemical and biological developments. The concentrations of total reactive phosphorus (TRP) and dissolved inorganic nitrogen are lower in the outlet than in the inlet channel. Taking fluxes of water into account the amount of TRP outflowing the ricefield through the channel is 28-80% of the TRP entering it through the inflowing channel. So, large amounts of phosphate and nitrogen were used in the ricefields. Nitrogen was shown to be the element captured more avidly in the ricefield. (Author's abstract)

Group 2H-Lakes

DISSOLVED ORGANIC MATTER IN COL-ORED WATER FROM MOUNTAIN BOG POOLS IN JAPAN: II. BIOLOGICAL DECOM-

Yamagata Univ. (Japan). Dept. of Chemistry.

Y. Satoh, and H. Abe. Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 1, p 25-35, November 1987. 4 fig, 2 tab, 15 ref.

Descriptors: *Japan, *Bogs, *Organic carbon, *Wetlands, *Decomposition, Nutrients, Bacteria, Biodegradation.

Microbial decomposability of dissolved organic carbon (DOC) in colored mountain bog water was examined at 15 C for 91 days. The decomposition caron (DCC) in colored mountain og water was examined at 15 C for 91 days. The decomposition process consisted of two stages. Both stages can be presumed to obey first order kineties. The addition of nutrients to the water sample slightly accelerated the decomposition. Although the reason is not clear, the addition of bacteria slightly suppressed the decomposition. The addition of both the nutrients and the bacteria greatly accelerated the decomposition. Artificial factors may have complicated the decomposition process which consisted of four stages in this case. Based on the results of both nutrient and bacteria added sample, about 40% of the initial DOC was microbially decomposable; the remaining 60% was very stable. It has been calculated that the decomposable fraction will be microbially exhausted within 320 days in nature if no organic matter is newly added. The DOC in colored water has been reported to be nature it no organic matter is newly added. Inte DOC in colored water has been reported to be significantly stable with regard to microbial de-composability. However, the present study has suggested that when microbial decomposability of DOC in colored water is discussed the age of DOC in question should be taken into account. (Author's abstract) W88-08810

FRESHWATER PLANKTON COMMUNITY SUCCESSION DURING EXPERIMENTAL ACIDIFICATION, Kent State Univ., OH. Dept. of Biological Sci-

For primary bibliographic entry see Field 5C. W88-08811

DECOMPOSITION AND NUTRIENT DYNAM-ICS OF LITTER OF QUERCUS PALUSTRIS
AND NELUMBO LUTEA IN A WETLAND
COMPLEX OF SOUTHEAST MISSOURI,

Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.

G. D. Wylie. Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 1, p 95-106, November 1987. 7 fig, 1 tab, 37

Descriptors: *Detritus, *Decomposition, *Nutrients, *Litter, *Wetlands, *Missouri, *Nitrogen, *Phosphorus, Carbon, Marshes, Reservoirs.

Weight loss and autrient dynamics of decomposing litter of Quercus palustris and Nelumbo lutea were studied in a wetland complex in southeast Missouri during 1981-83. Leaf litter of Q. plaustris lost 24-38% of original ash-free dry weight (AFDW) in 12 months with calculated annual decay constant (k)-values of 0.38-0.72/yr. Litter of N. lutea lost 80% of original AFDW in 8-9 months with k-values of 1.54-2.08/yr, significantly greater than those for Q. palustris. Decomposition of Q. palustris was not significantly different between temporarily and permanently flooded sites. Decomposition rates of N. lutea were significantly greater in temporarily flooded marsh sites than in a permanent reservoir. During this study, mass of N and P in litter of both taxa increased to original levels or greater, and subsequently ratios of C:N and C:P declined, sugesting microbial colonization of litter. Results indicate that decomposition of litter of Q. palustris and N. lutea in these wetlands improves quality of litter as food for invertebrate detritivores in the area and conserves N and P with respect to the litter as food for invertebrate detritivores in the area and conserves N and P with respect to the potential life history requirements of each plant species. (Author's abstract)
W88-08812

PALEOLIMNOLOGY OF A LARGE SHALLOW LAKE; COOKING LAKE, ALBERTA, CANADA, Alberta Univ., Edmonton. Dept. of Botany. M. Hickman.

M. Hickman. Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 1, p 121-136, November 1987. 7 fig, 4 tab, 45 ref. Natural Sciences and Engineering Research Council of Canada Grant NSERC A6384.

Descriptors: *Paleolimnology, *Canada, Shallow water, *Water level fluctuations, *Lakes, Erosion, Sediments, Diatoms, Benthic fauna, Lake sedi-ments, Cooking Lake, Alkaline water.

ments, Cooking Lake, Alkaline water.

The paleolimnological history of a large shallow lake, Cooking Lake is presented. This lake is of interest because levels have been reported to be receding at an average of 6.1 cm/yr since the turn of the century with only two reversals happening during this period. The core retrieved from the lake spans nearly 6000 years and can be divided into two broad regions: (1) an early unproductive period characterized by high erosional input, and (2) after the present day vegetation had become established, a productive period. It was during this latter period that diatoms were found which confirm visual evidence that the lake levels are steadily falling. The diatom taxa are those characteristics of alkaline, high pH, and eutrophic conditions. Within the upper 55 cm of the core, planktonic diatoms decrease rapidly with a concomitant increase in benthic taxa which reflects the observed falling water levels in this century. (Miller-PTT) W88-08814

EVALUATION OF SIZE-RELATED CHANGES IN CHLOROPHYLL-SPECIFIC LIGHT EXTINCTION IN SOME NORTH TEMPERATE LAKES,

California Univ., Davis. Div. of Environmental Studies

Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 171-182, December 1987. 5 fig, 2 tab, 23

Descriptors: *Limnology, *Lakes, *Chlorophyll, *Color, *Light penetration, *Algae, Cell size, Algal chlorophyll.

The effect of cell size on chlorophyll-specific light extinction (the 'package effect') was investigated by examining the size distribution of algal chlorophyll relative to light extinction both in a broad survey of twenty lakes in Michigan and Wisconsin with differing concentrations of dissolved color with differing concentrations of dissolved color and chlorophyll and in an intensive study of two relatively low color lakes (Paul and Peter lakes). In the lakes sampled in the lake survey, water color was the dominant factor influencing light penetration. This factor, along with a significant correlation between water color and chlorophyll concentration made the effects of algal size on light extinction difficult to evaluate. No evidence for the operation of the package effect was found in these data. In Peter and Paul lakes, chlorophyll-specific light extinction was higher when nanoplankton dominated the algal community. This result suggests that, in relatively uncolored lakes and in the cocan, changing the algal size distribution will ocean, changing the algal size distribution will have significant effects on the penetration of light in the water column. (Author's abstract) W88-08815

PHYTOPLANKTON SUCCESSION IN RELA-TION TO THE NITROGEN REGIME IN SHAL-

TION TO THE NITROGEN REGIME IN SHALLOW, BRACKISH-WATER FISHPONDS, Hebrew Univ. of Jerusalem (Israel). Div. of Microbial and Molecular Ecology.

J. VanRijn, S. Diab, and M. Shilo.
Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 183-196, December 1987. 6 fig. 1 tab, 22 cref. German-Israeli Research Program on Aquaculture grant NCRD project GR 154/AQ10.

Descriptors: *Phytoplankton, *Succession, *Nitro-gen, *Shallow water, *Ponds, *Fish ponds, *Bacte-ria, Algae, Brackish water, Cyanobacteria, Season-al variation, Ammonia.

A seasonal succession of phytoplankton is typical for fish ponds in Israel. In winter, and spring, a

wide variety of eukaryotic algae inhabit the ponds, while in summer a limited number of gas vacuolated cyanobacteria are dominant. A significant correlation was found between the inorganic nitrogen content of the ponds in the different seasons, and the specific affinities of the different seasons, and the specific affinities of the different algae, cyanobacteria and nitrifying bacteria towards ammonia. It is suggested that the different affinities play a major part in the succession pattern observed in the ponds. Sensitivity to photooxidation and the ability to carry out vertical migration from the auriace to the nitrogen rich sediment were also important in the relative abundance of different phytoplankton types in different periods. (Author's phytoplankton types in different periods. (Author's ostract) W88-08816

MICROBIAL INVESTIGATIONS IN RIVERS: VI. THE BACTERIAL POPULATIONS ION THE INFLOW AND THE OUTLET OF A SMALL LAKE, Kiel Univ. (Germany, F.R.). Inst. fuer Meeres-

C. Schulz, and G. Rheinheimer. Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 235-244, December 1987. 1 fig, 3 tab, 15 ref.

Descriptors: *Bacteria, *Rivers, *Germany, *Lakes, *Limnology, *Microbiological studies, Hydrography, Water level fluctuations, Sapro-

Many rivers in Ostholstein (Northern Germany) repeatedly cross lakes and reservoirs. This paper investigates how far structure and function of the bacterial population of a small river change when the river flows through a lake. During an annual cycle both bacteriological and hydrographic parameters were determined. The lake considerably affected the quantity and function of the bacterial populations of the river: (1) The lake can dampen parameters of the river, a fluctuating input being opposed to a relatively constant output. This holds true for the saprophytes and the maximum uptake velocity for glucose. (2) The lake can also cause fluctuation, an even input being opposed to remarkable fluctuations at the outlet. This was particularly true for the total number of bacteria. (Author's abstract) (Author's abstract)

NICHE STATISTICS OF SUBMERGED MA-CROPHYTES IN TYRIFJORD, A LARGE OLI-GOTROPHIC NORWEGIAN LAKE,

Norsk Inst. for Vannforskning, Oslo.

Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 283-308, December 1987. 10 fig, 5 tab, 57 ref. Norwegian Institute for Water Research grant OF-81620.

Descriptors: *Limnology, *Light penetration, *Niches, *Macrophytes, *Norway, *Lakes, Oligotrophic lakes, Water level fluctuations, Water temperature, Temperature effects, Spatial distribution, Statistics, Aquatic plants, Submerged plants.

The spatial niches of submerged macrophytes and the appropriate statistics related to niche exten-sions and their boundaries are described and the sions and their boundaries are described and the relevance to niche, competition and disturbance theories is evaluated. This approach is exemplified by an analysis of the prevailing macrophytes in the large oligotrophic lake Tyrifjord (SE Norway) in which water levels had an annual mean fluctuation of 2.0 m and a total range of 3.5 m. Water temperature gradients were negligible within the vegetated zone. Light climate showed clear vertical and horizontal gradients. An exposure gradient, comprising wind fetches from near zero up to 9 km, related to lake floor erosional activity and substrate type changes. Aquatic macrophytes occurred within a 9 m vertical zone, but the abundance of submersed species concentrated in the 1.1-4.2 m depth range. m vertical zone, but the abundance of submersed species concentrated in the 1.1-4.2 m depth range. Niche interrelationships of the three prevailing Tyrifjord macrophytes indicate that Myriophyllum alterniforum Dc. occurred quite independant of the isoetids, Isoetes lacustris L., and Littorella uni-flora (L.) ASCHERS. These isoetids shared upper limits, due to substrate inavailability, but their lower spatial limits diverged along exposure and light gradients. These relationships strongly indi-cate a negligible role of interspecific competition to the development of macrophyte zonation. The evidence presented shows that water temperature evidence presented shows that water temperature is not in control of niche size or macrophyte spatial performance. Neither could within-lake performance of the macrophytes be related to substrate factors. Regarding downslope performance, however, the data indicate a prime influence of the underwater light climate. (Author's abstract)

DETRITUS ASSOCIATED RESPIRATION DURING MACROPHYTE DECOMPOSITION, Central Inst. of Freshwater Aquaculture. Bhuban

Central Inst. of Freshwater Aquaculture, Bnuoan-eswar (India).
J. Olah, V. R. P. Sinha, S. Ayyappan, C. S. Purushothaman, and S. Radheyshyam. Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 309-315, December 1987. 2 fig, 1 tab, 8 ref.

Descriptors: *Detritus, *Macrophytes, *Decomposition, *Respiration, *Biomass, *Oxygen demand, Swamps, Fish ponds, Aquatic plants.

The detritus associated respiration levels in the The detritus associated respiration levels in the dominant tropical aquatic macrophytes were measured along with their decomposition patterns in different systems such as a swamp and manured fish pond. More resistant plants like Eichhornia and Salvinia showed lower decay losses and respiration rates compared to Najas and Hydrila. The respiration of macrophytes during decomposition depended on their composition and foliage along with biomass, indicating a constant oxygen demand in a composite macrophyte system like a swamp. (Author's abstract)
W8R-08825 W88_08877

SUMMER EVOLUTION OF TURBIDITY IN LAKE NEUCHATEL. (EVOLUTION ESTIVALE DE LA TURBIDITE DANS LE LAC DE NEU-

Neuchatel Univ. (Switzerland). Lab. de Mineralogie, Petrographie et Geochim A. Bapst, and B. Kubler.

A. Dapst, and B. Kubler.
Schweizerische Zeitschrift fuer Hydrologie
SZHYA6, Vol. 49, No. 1, p 1-15, 1987. 15 fig. 17
ref. Fonds National Suisse de la Recherche Scientifique projets no. 2 893-0.83, 2 311-0.84, and 2 639-

Descriptors: *Limnology, *Turbidity, *Physical properties, *Lakes, *Seasonal variation, Chemical properties, Lake Neuchatel, Stratification, Thermal stratification, Epilimnion, Hypolimnion.

Physicochemical water evolution (temperature, dissolved oxygen, pH, conductivity) was studied in Lake Neuchatel during 1985. The results showed that as soon as thermal stratification established, the epilimnion experiences a high particulate intensification was caused by biological proliferation and later by carbonate precipitation. The hypolimnion could be divided into three layers which can change in individual amplitude during the summer: nion could be divided into three layers which can change in individual amplitude during the summer: (1) the Clear Water Layer (CWL) at the top which contains a very weak particulate concentration; (2) the Benthic Nepheloid Layer near the bottom which periodically shows a high particulate enrichment; and (3) a Pelagic Nepheloid Layer in between the other two which is slightly more concentrated than the CWL. (Miller-PTT) W88-08823

GRAVITATIONAL OSCILLATIONS THROUGH THE CHANNEL IN MELIDE DAM DUE TO COUPLING OF THE LUGANO BASINS. (DIE EIGENSCHWINGUNGEN DER DURCH DEN KANAL IM DAMM VON MELIDE GEKOPPELTEN BECKEN DES LU-GANERSEES),

GANERSEES), Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie. For primary bibliographic entry see Field 8B. W88-08824

LIMNOLOGICAL INVESTIGATION OF BIOGENIC SILICA SEDIMENTATION AND SILICA BIOGEOCHEMISTRY IN LAKE ST. MORITZ AND LAKE ZURICH, Michigan Univ., Ann Arbor. Great Lakes Re-

For primary bibliographic entry see Field 5C. W88-08826

(LA MORTE DU SAGET, UN ANCIEN MEANDRE DU RHONE: BILAN HYDROLOGI-QUE ET BIOGEOCHIMIQUE), Lyon-1 Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces. G. Carrel, and J. Juget. Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 1, p 102-125, 1987. 7 fig, 4 tab, 23 ref.

Descriptors: *Lakes, *Eutrophication, *Encroachment, *Alluvial plains, *Oxbow lakes, *France, *Flooding, Lake sediments, Cutoff lakes, Mean-

The 'Morte du Sauget', a typical oxbow lake in the process of eutrophication and encroachment, is located in the alluvial plain of the French Upper Rhone River. Studies during 1983 have shown that, although the 'Morte du Sauget' is seasonally inundated by the Rhone, the impact of flooding is only temporary and is minimized by the biological activity of the waters and sediments of this system. Following an exponential rhythm during the last few decades, the sediment contains increased quantities of organic plant material. (Miller-PTT) W88-08827

SEDIMENTATION RATES IN THE CENTRAL LAKE CONSTANCE DETERMINED WITH 210PB AND 137CS,

Bern Univ. (Switzerland). Radiochemisches Lab. H. R. Von Gunten, M. Sturm, H. N. Erten, E. Rossler, and F. Wegmuller. Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 3, p 275-283, 1987. 3 fig, 3 tab, 27 ref.

Descriptors: *Lake Constance, *Sedimentation, *Isotope studies, *Lake sediments, *Sedimentation rates, Cesium radioisotopes, Lead radioisotopes, Suspended solids, Sediment-water interface.

Sediment cores from central Lake Constance were dated with 210Pb and 137Cs. A sedimentation rate (0.11 + or -0.02) g/sq cm/yr was determined with the 210Pb method. 137Cs measurements revealed sedimentation rates of (0.11 = or -0.01) g/sq cm/yr for two different cores sampled at the same location. The lower CS-dated value indicates incomplete core recovery and demonstrates the sensitivity of this simple dating method to small losses of material at the water-sediment interface. An unambiguous application of the 137 Cs method is, therefore, only possible if complete core recovery is ensured. Sedipossible if complete core recovery is ensured. Sedi-mentation rates based on particulate matter, colmentation rates based on particulate matter, con-lected in sediment traps at various water depths, agree with the results of the radioisotope methods. Estimates of 30-125 days residence times for sus-pended particulate matter were calculated from 7Be measurements. (Author's abstract)

SETTLING VELOCITY AND RESIDENCE TIME OF PARTICLES IN LAKE CONSTANCE, Konstanz Univ. (Germany, F.R.). Limnological

Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 3, p 284-293, 1987. 4 fig. 1 tab, 23 ref. Deutsche Forschungsgemeinschaft Grant Ti 115/2-3.

Descriptors: *Settling velocity, *Residence time, *Lake Constance, *Suspended solids, *Sedimentation, Seasonal variation, Organic matter, Delritus,

Seasonal and spatial aspects of the net settling velocities of particles in Lake Constance were

investigated by measurements of settling fluxes and investigated by measurements of settling fluxes and estimates of suspended matter. Annual mean sinking velocities ranged from 2.6 m/d in the euphotic zone to 7.5 m/d in the aphotic zone. Summer maxima of 3.6 m/d were caused by settling calcite crystals while minima of 0.4 m/d during the clear water phase resulted from particulate matter consisting mostly of phytoplankton and organic debris. Winter settling velocities averaged 1.2 m. The mean residence time for the bulk of particles calculated on an annual basis was 27.8 days. The net settling velocities were higher than those calculating velocities were higher than those calculated for phytoplankton in other investigations but ed for phytoplankton in other investigations but agreed with estimates from Lake Zurich obtained by a similar approach. (Author's abstract) W88-08829

GRAZING BY A COLORLESS FLAGELLATE ON A GREEN ALGAL BLOOM,

Moi Univ., Eldoret (Kenya).

L. Ramberg. Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 3, p 294-302, 1987. 3 fig. 23

Descriptors: *Flagellates, *Limnology, *Eutrophication, *Nutrients, *Grazing, Sweden, *Eutrophic lakes, Lakes, Phytoplankton, Lake Gunillajaure,

At the end of the summer of 1979, phytoplankton from the experimentally fertilized Lake Gunillajaure in Northern Sweden were examined. A dense green, almost moncultural, population of a small Chlorococales algae was found along with an usually high density of a colorless flagellate which fed on the green algae. An intensive study was initiated and within 5 days, the dense bloom of green algae was reduced by 97%. This was probably caused by grazing by the flagellate whose population increased logarithmically to a high number and disappeared as quickly. The green algae then increased rapidly and mucilage lumps excreted by the flagellate were colonized by a specialist Chlamydomonas. The flagellate attach was probably enhanced by the high density and the physiological weakness of the green algae due to a very low growth caused by a shortage of inorganic carbon. The flagellate's grazing apparently caused an increase in inorganic autrients that promoted an increase in inorganic nutrients that promoted the subsequent growth of the green algae. (Miller-PTT W88-08830

VERTICAL MIGRATION OF PLANKTONIC COPEPODS IN LAKE CONSTANCE, (ZUR VERTIKALAWANDERUNG PLANKTISCHER COPEPODEN IM BODENSEE-OBERSEE), Landesanstalt fuer Unweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.). Inst. fuer Seenforschungs Fischereiwesen. U. Einsle.

Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 3, p 303-315, 1987. 7 fig, 18

Descriptors: *Life cycles, *Plankton, *Lake Constance, *Copepods, *Limnology, *Migration, *Crustaceans, *Lakes, Photoperiodism, Diurnal stance, *Copepods, *Limno *Crustaceans, *Lakes, Photo distribution, Vertical distribution

Long-term investigations on the annual cycles of planktonic crustaceans in Lake Constance were completed in 1960 and 1963 and a number of day-night samples were taken. Amplitudes of vertical movements for some copepods, especially different instars, are presented. The numbers in the net hauls show a coarse but clear picture of these migrations. The role of the diurnal vertical migration for the release of diapause in Cyclops cicinus is discussed. (Author's abstract) W88-08831

WHITEFISH AS INDICATORS OF CULTURAL EUTROPHICATION,

Statliches Inst. fuer Seenforschung und Fischer-eiwesen, Langenargen (Germany, F.R.). For primary bibliographic entry see Field 5C. W88-08832

Group 2H-Lakes

COMPARATIVE STUDY ON THE TEMPERA-TURE DEPENDENCE OF EMBRYOGENESIS IN THREE COREGONIDS (COREGONUS SPP.) FROM LAKE CONSTANCE.

Konstanz Univ. (Germany, F.R.). Limnological

R. Eckmann

Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 3, p 353-362, 1987. 2 fig, 5 tab, 24 ref.

Descriptors: *Fish, *Lake Constance, *Cisco, *Incubation, *Model studies, *Temperature effects, Hatching, Larval growth stage, Lakes, Comparison studies, Embryonic growth stage.

Embryogenesis of the three coregonid forms Blaufelchen, Gangfisch, and Sandfelchen from Lake
Constance was observed at five different constant
temperatures in a static incubation system. The
relationship between temperature and the time to
reach 14 development stages from fertilization to
hatching was established for the three forms. Relative to the total incubation time, pectoral fin flutter
and eye movement start earliest in Gangfisch and
latest in Blaufelchen. This might allow Gangfisch
to tolerate lower oxygen concentrations during the
last phase of embryogenesis than Blaufelchen. Developmental rates per day as a function of temperature can be calculated by a power function. A
model is presented which permits the prediction of
the time of mass hatching for embryos which are
incubated at fluctuating temperatures. The total
incubation times for the three coregonids of Lake
Constance are short as compared to those of other
coregonids. This is interpreted as an adaptation to
the specific thermal environment of each coregonid stock which helps to ensure larval survival
in the respective habitats. (Author's abstract)
W88-08833

WHITEFISH (COREGONUS LAVARETUS (L.)) OF THE WAHNBACH RESERVOIR AND THEIR ASSESSMENT BY HYDROACOUSTIC METHODS.

Landesanstalt fuer Fischerei Nordrhein-Westfalen, Kirchhundem (Germany, F.R.). For primary bibliographic entry see Field 81. W88-08834

EFFECT OF INTENSIVE FERTILIZATION OF A BANKSIDE MEADOW ON THE ACTIVITY OF PLANKTON BACTERIA IN THE RIVER NIDA (SOUTHERN POLAND),

Polish Academy of Sciences, Krakow. Zaklad Bio-For primary bibliographic entry see Field 5C. W88-08835

EFFECT OF DAM RESERVOIRS ON OLIGO-CHAETE COMMUNITIES IN THE RIVER DUNAJEC (SOUTHERN POLAND), Polish Academy of Sciences, Krakow, Zaklad Bio-

F Dumnicks

Acta Hydrobiologica AHBPAX, Vol. 29, No. 1, p 25-34, 1987. 2 fig, 3 tab, 18 ref.

Descriptors: *Oligochaetes, *Stream biota, *Ecological effects, *Ecosystems, *Annelids, *Reservoirs, *Species composition, *Limnology, *Biomass, *Population dynamics, *Trophic level, Water resources development, Aquatic habitats, Rivers, Rivers Dunaics. Rivers, River Dunajec.

In the studied section of the Dunajec and in two dam reservoirs 47 oligochaete species were found. In the reservoirs and silted river sectors Tubificidae dominated and at the remaining stations Naidi-dae. The structure of dominance depended on the age. I he structure of dominance depended on the type of bottom, and the trophicity of the water. Hydrotechnical development indirectly affected the structure of the communities, modifying the living conditions of the oligochaetes by changing the velocity of the current and the character of the river bottom below the reservoir. (Author's abstract) W88_08837

DIVERSITY AND NUMBERS OF OLIGO-CHAETA AGAINST THE BACKGROUND OF OTHER MACROINVERTEBRATES IN A CON-CRETE BED OF THE RIVER WIDAWKA (CEN-TRAL POLAND), Lodz Univ. (Poland). Inst. of Environmental Biol-

ogy. K. Kahl, and M. Golanska. Acta Hydrobiologica AHBPAX, Vol. 29, No. 1, p 35-51, 1987. 5 fig, 1 tab, 24 ref.

Descriptors: *Stream biota, *Species diversity, *Annelids, *Substrates, *Oligochaetes, *Macroin-vertebrates, *Species composition, *Population dy-namics, *Limnology, *Biomass, Aquatic habitats, River Widawka, Hidges, Rivers.

Macrofauna inhabiting the concrete bed of the River Widawka were studied in an annual cycle. Besides Chironomidae, Oligochaeta occurred in the largest numbers and this group was analyzed in detail. 13 species of Oligochaeta of the Naididae family, 1 species of the Lumbriculidae family and unidentified specimens of the families Tubificidae and Enchytraeidae were recorded. Changes in the dominance of the different groups of macrofauna and different species of Oligochaeta and the dynamics of their numbers were investigated. (Author's abstract) thor's abstract) W88-08838

BENTHOS AND DRIFT OF INVERTEBRATES, PARTICULARLY CHIRONOMIDAE, IN A SELECTED CROSS-SECTION PROFILE OF THE RIVER WIDAWKA (CENTRAL POLAND), Lodz Univ. (Poland). Dept. of Ecology and Verte-

brate Zoology.

M. Grzybkowska, D. Pakulska, and H. vski.

Jakubowski. Acta Hydrobiologica AHBPAX, Vol. 29, No. 1, p 89-109, 1987. 6 fig, 3 tab, 40 ref.

Descriptors: *Stream biota, *Benthic fauna, *Zoo-plankton, *Midges, *Oligochaetes, *Macroinverte-brates, *Species composition, *Population dynam-ics, *Limnology, *Biomass, River Widawda, Aquatic habitats, Sediments, River.

An investigation of meso- and macrobenthos was carried out in the annual cycle. Chironomidae and Oligochaeta constituted about 80.6% of the bottom fauna. Drifting benthic fauna was chiefly represented by young specimens of Chironomidae and Oligochaeta < 1 mm. A very large share of zoobenthos in the drift was observed. No statistically significant correlation was found between the density of invertebrates in bottom sediments and of those drifting in the water either at the lead of sty of inverteurs in cottom section and of those drifting in the water, either at the level of species or higher taxonomic units (p > 0.05), (Author's abstract)

PLANKTON STRUCTURE AND DYNAMICS, PHOSPHORUS AND NITROGEN REGENERATION OF ZOOPLANKTON IN LAKE GLEBOKIE POLILUTED BY AQUACULTURE, Polish Academy of Sciences, Lomianki. Inst. Ekotesii

For primary bibliographic entry see Field 5C. W88-08841

REED (PHRAGMITES AUSTRALIS (CAV.) TRIN. EX STEUD.) GROWTH UNDER CONDI-TIONS OF INCREASING EUTROPHICATION OF LAKE MIKOLAJSKIE,

Polish Academy of Sciences, Mikolajki. Inst. of Ecology.

J. Krolikowska

Ekologia Polska ELPLBS, Vol. 35, No. 1, p 209-217, 1987. 5 fig, 1 tab, 22 ref.

Descriptors: *Lakes, *Reeds, *Aquatic weeds, *Plant growth, *Eutrophication, *Seasonal variation, *Biomass, *Aquatic plants, Lake Mikolajskie,

Seasonal changes of reed production indices, with special consideration of plant density, length of shoots and biomass of aboveground parts, were analyzed in 1985 in the reed-belt of Lake Mikolajs-

kie. In comparison with 1967, the reed-belt area, density and biomass decreased mainly as a result of mechanical damage of shoots by filamentous algae abundantly accumulating in the littoral of emergent plants. (Author's abstract) W88-08842

PHOSPHATE EXCHANGE BETWEEN SEDI-MENTS AND THE NEAR-BOTTOM WATER IN RELATIONSHIP TO OXYGEN CONDITIONS IN A LAKE USED FOR INTENSIVE TROUT CAGE CULTURE,

Polish Academy of Sciences, Lomianki. Inst. Eko-

For primary bibliographic entry see Field 5C. W88-08843

HYDROBIOLOGICAL STUDY OF THE OSSAU VALLEY (ATLANTIC PYRENEES): I. DISTRI-BUTION AND ECOLOGY OF EPHEMEROP-TERA (ETUDE HYDROBIOLOGIQUE DE LA VALLEE DOSSAU (PYPENES,ATLANTI-VALLEE D'OSSAU (PYRENEES-ATLANTI-QUES): I. REPARTITION ET ECOLOGIE DES

G. Vincon, and A. G. B. Thomas. Annales de Limnolgie ANLIB3, Vol. 23, No. 2, p 95-113, 1987. 6 fig, 5 tab, 33 ref.

Descriptors: "Hydrobiology, "Insects, "Species composition, "Stream biota, "Mayflies, "Ecology, "Population dynamics, France, Temporal distribution, Ossau Valley, Spatial distribution, Catchment areas, Hydrology, Taxonomy.

29 running-water stations were surveyed in the Ossau valley (Atlantic Pyrenees) between altitudes of 450 m and 2,150 m, and 30 species of Ephemeroptera were recorded. The data were analyzed optera were recorded. In en data were analyzed using two factorial analyses, one of which included the environmental parameters, and an ascending hierarchic classification. These analyses divided the species into five groups: I. from very cold streams at high altitude; III. from mountain streams at mean altitude, and streams at high altitude but with high summer temperatures, IIa. from rivers of the piedmont region (lower region of mountains), IIIa. from fairly slow-flowing rivers with a high level of calcium; IIIb. from very slow-flowing rivers with muddy bottom rich in macrophytes. The thermal and current speed were the chief factors affecting distribution of the mountains. Al-titude, catchment area, stream order, hydrological titude, catchment area, stream order, hydrological regime and physical-chemical characteristics also played an important role. The ecological preferences of the principal species are discussed. (See also W88-08846) (Author's abstract)

ECOLOGY OF A FREE-FLOWING RIVER IN THE SOUTH OF THE ALPS- THE BUECH (FRANCE): I. LONGITUDINAL EVOLUTION OF PHYSICAL AND CHEMICAL DESCRIP-TORS (ECOLOGIE D'UNE RIVIERE NON AMENAGE DES ALPES DUE SUD- LE BUECH: (FRANCE) I. EVOLUTION LONGITU-DINALE DES DESCRIPTEURS PHYSIQUES ET CHIMIQUES),

Aix-Marseille-1 Univ. (France). Lab. d'Hydrobio-

For primary bibliographic entry see Field 5C. W88-08845

HYDROBIOLOGICAL STUDY OF THE OSSAU HIDROSIOLOGICAL SPOT OF THE OSSAC VALLEY (ATLANTIC PYRENEES) II: THE ENVIRONMENT AND THE STRUCTURE OF THE BENTHIC POPULATION, (ETUDE HYDROBIOLOGIQUE DE LA VALLEE D'OSSAU (PYRENEES-ATLANTUES) II: LE MILIEU ET LA STRUCTURE DU PEUPLEMENT BENTHI-

Toulouse-3 Univ. (France). Lab. d'Hydrobiologie. G. Vincon.

Annales de Limnolgie ANLIB3, Vol. 23, No. 3, p 225-243, 1987. 5 fig, 4 tab, 46 ref.

Descriptors: *Stream biota, *Aquatic environment, *Benthic fauna, *Hydrobiology, *Insects, *Macroinvertebrates, *Species composition, *Popula-

Lakes-Group 2H

tion dynamics, *Limnology, Temporal distribution, Ossau Valley, France, Spatial distribution, Hydrol-ogy, Taxonomy.

Collections of benthic invertebrates have been taken in the Gave d'Ossau, a river in the Atlantic Pyrenees, and in its principal tributaries, between altitudes of 450 m and 2150 m. After presenting a alitudes of 450 m and 2150 m. After presenting a detailed description of the environment, a list of the most interesting species is presented: 7 species are new to science, 16 species are new records for zone 2 in the Limnofauna Europaea. The longitudinal succession of the biocoenoses and their composition have been analyzed. In the Gave d'Ossau, there is a gradual replacement of upstream species by downstream species rather than a succession of strictly defined communities; a zonation scheme for running waters is apparently difficult to apply to mountain rivers. (See also W88-08844) (Author's abstract) abstract) W88-08846

DEPENDENCE OF SURFACE VELOCITY IN WATER BODIES ON WIND VELOCITY AND

Salford Univ. (England). Dept. of Mathematics Salford Univ. (Engants).

and Computer Science.

B. Henderson-Sellers.

Applied Mathematical Modeling AMMODL, Vol.

12, No. 2, p 202-203, April 1988. 11 ref.

Descriptors: *Surface velocity, *Wind velocity, *Model studies, *Lakes, *Hydrodynamics, *Latitudinal studies, *Limnology, *Mathematical studies, Hydrology, Simulation, Prediction, Atmospheric physics, Lake Huron, Equations.

In analysis of the hydrodynamics of large and small water bodies, a relation is frequently required between surface velocity. U sub s, and wind speed, U. Here a theory is developed to explain the observed relationship between surface velocity in a water body and both wind speed and latitude. Although the surface level of a water body is ill-defined, largely as a result of wave action, it is often necessary to postulate a value for the surface current to complete model specification of the current profile and possible to relate this surface velocity to observed atmospheric variables. It is suggested here that a useful representation is the equations presented. Recent measurements in Lake Huron, together with earlier observations, substantiate this relatively simple parameterization. (Alexander-PTT) In analysis of the hydrodynamics of large and ander-PTT) W88-08849

FURTHER STUDIES OF SHORT-TERM VARIATION IN THE PIGMENT COMPOSITION OF A SPRING PHYTOPLANKTON BLOOM, Institute of Oceanographic Sciences,

(England).

P. S. Ridout, and R. J. Morris. Marine Biology MBIOAJ, Vol. 97, No. 4, p 597-602, April 1988. 8 fig, 19 ref.

Descriptors: *Pigments, *Eutrophication, *Estuaries, *Phytoplankton, *Chromatography, *Chlorophyll a, Sedimentation, Limiting nutrients, Chemical properties, Loch Ewe, Trophic level, Lakes, Als

Phytoplankton sampled at the chlorophyll maximum during the spring bloom at Loch Ewe, Scotland during 1986, were analyzed using high-performance liquid chromatography for chloropigments and carotenoids. The day-to-day proportions of the pigments remained relatively stable throughout the bloom, with good preservation of chlorophyll a even at the sediment surface. Chlorophyllide a and phaeophorbide a appeared towards the end of the bloom. The major carotenoids remained stable throughout the bloom, but became rapidly degraded on sedimentation under the toxic conditions. The pigment data is related to the nutrient status of the bloom, when slow steady growth occurred without nutrient limitation. These data contrast sharply with data from the 1983 spring bloom at Loch Ewe when acute nutrient limitation took place. (Author's abstract)

EFFECTS OF RECENT ACIDIFICATION ON CLADOCERA IN SMALL CLEAR-WATER LAKES STUDIED BY MEANS OF SEDIMEN-

TARY REMAINS, Joensuu Univ. (Finland). Karelian Inst. For primary bibliographic entry see Field 5C. W88-08855

PHYSICS OF SEDIMENT TRANSPORT, RESUSPENSION, AND DEPOSITION,

National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

For primary bibliographic entry see Field 2J. W88-08856

RECENTLY LANDLOCKED BRACKISH-WATER LAGOON OF LAKE TANGANYIKA: PHYSICAL AND CHEMICAL CHARACTERIS-TICS, AND SPATIO-TEMPORAL DISTRIBU-TION OF PHYTOPLANKTON,

Universite du Burundi, Bujur

A. G. Caljon. Hydrobiologia HYDRB8, Vol. 153, No. 1, p 55-70, October 1987. 14 fig, 1 tab, 39 ref.

Descriptors: "Salinity, "Lake Tanganyika, "Lim-nology, "Phytoplankton, "Lakes, "Lagoons, "Lakes, "Lagoons, "Seasonal variation, "Cycling nutrients, Species composition, Heavy metals, Suc-cession, Physical properties, Chemical properties, Limiting nutrients, Eutrophication, Spatial distri-bution, Diatoms, Algae, Temporal distribution.

Monthly measurements of physical and chemical characteristics were made at two localities in the eastern part of a recently landlocked lagoon of Lake Tanganyika. Variables analyzed were: temperature, pH, conductivity, sodium, potassium, magnesium, calcium, carboante, bicarbonate, chloride and sulfate. Large seasonal fluctuations of salinity were recorded (1.68 - 8.21 g/L). The seasonal water input controlled aleas seasonality sonal water input controlled algal seasonality mainly through its effect on salinity and indirectly mainly through its effect on salinity and indirectly through its influence on nutrient concentration by dissolution and dilution of the excrement of numerous cattle and other organic matter. Phytoplankton was mainly composed of Cyanophyta and Euglenophyta. Euglenophyta dominated during the dry periods with high salinity and probably very high nutrient levels, while Cyanophyta preferred moderate salt and nutrient concentrations during the rainy periods. The phytoplanktonic community was composed of a large number of perennial and a reduced quantity of annual organisms. A spatial study of the recently landlocked lagoon revealed an ascending salinity gradient, principally due to a sodium bicarbonate/carbonate enrichment, between locations near the lake and more inland situated stations. These facts point to a lake water supply and a salt concentration by evaporation in the swamps. Proportionally lower magnesium, calsupply and a sait concentration by evaporation in the swamps. Proportionally lower magnesium, calcium and potassium values were recorded at high salinities, due to chemical precipitation and biotic factors. A blue-green bloom was observed in the eastern water-body (salinity: 4.64 g/L); simultaneously an important development of diatoms dominated the western water-body (salinity: 2.18 g/L). No significant differences in morphometry, exposure, water temperature or nutrient levels (nitrate, nitrite, ammonia, orthophosphate) were ob-served. The relatively low salinity and high nutriserved. The relatively low salinity and high nutri-ent concentration in the western water-body prob-ably favored diatom development during the rainy season. The relatively higher salinity in the eastern water-body during the rainy season was probably responsible for the dominance of blue-green algae through its negative influence on silica concentra-tions and notwithstanding the high inorganic nitro-gen concentration. (Author's abstract) W88-08870

REMOVAL OF FLOODWATER NITROGEN IN A CYPRESS SWAMP RECEIVING PRIMARY WASTEWATER EFFLUENT, Central Florida Research and Education Center,

Sanford, FL.

For primary bibliographic entry see Field 5D. W88-08871

FACTORS CONTROLLING PRIMARY PRO-DUCTION IN TWO RIVERS RESULTING FROM A REDUCTION IN FLOW, (FACTEURS CONTROLANT LA PRODUCTION PRIMAIRE DANS DEUX RIVIERES SOUMISES A UNE FORTE REDUCTION DE DEBIT),

Quebec Univ., Montreal. Dept. of Biological Sci-

L. Lapierre, and D. Planas. Hydrobiologia HYDRB8, Vol. 153, No. 2, p 109-119, October 1987. 3 fig, 5 tab, 36 ref.

Descriptors: *River flow, *Primary productivity, *Limnology, *Stream biota, *Phytoplankton, *Biomass, *Chlorophyll a, Light quality, Algae, Rivers, Diversion, Flow.

The effects of river diversion on phytoplankton primary production and biomass in the down-stream part of two rivers were studied in relation to physical and chemical variables. These rivers, situated north of the 52nd parallel, are characterissituated north of the 52nd parallel, are characteristic of oligotrophic systems with phytoplankton primary production less than 10.76 mg C/sq m/hr, chlorophyll-a lower than 3.0 mg/cu m and biomass between 118-1007 mg/cu m. The decrease in flow favored the establishment of an algal biomass approximately two times greater then that present before diversion. This increase in biomass was associated in one river with an increase of 2.5 times of the mean primary repoluction. In the other river of the mean primary production. In the other river the primary production per unit of surface areas remained stable but increased when expressed by unit volume, due to a great decrease in underwater light penetration, a consequence of inorganic par-ticulate matter increase. (Author's abstract) W88-08872

TYPOLOGY OF OLIGOTROPHIC STREAMS OF THE ARDENNE (BELGIUM) BY MULTI-VARIATE ANALYSIS OF BENTHIC DIATOMS VARIATE ANALYSIS OF BENTHIC DIATOMS RECORDS (TYPOLOGIE DES RIVIERES OLI-GOTROPHES DU MASSIF ARDENNAIS (BEL-GIQUE) PAR L'ANALYSE MULTIVARIEE DE RELEVES DE DIATOMEES BENTHIQUES),

Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium). Lab. de Botanique. L. Leclercq, and E. Depiereux.

Hydrobiologia HYDRB8, Vol. 153, No. 2, p 175-192, October 1987. 8 fig, 1 tab, 26 ref.

Descriptors: *Stream biota, *Stream biota, *Species composition, *Oligotrophy, *Diatoms, *Ardennes, *Belgium, *Multivariate analysis, *Statiscal methods, Model studies, Aquatic habitats, Physical properties, Ecological effects, Taxonomy, Light quality, Eutrophication, Streams.

During three years, samples of water and algae were taken in 72 stations distributed on the river system of the northern part of the Ardennes. 357 taxa of diatoms have been identified. Principal component analysis and cluster analysis, applied to diatoms counts allowed the records in a state to diatoms counts allowed the records in a state of the state o diatoms counts, allowed the records in a table comparable to phytosociological tables. A continuum in the data is an indication of the progressive modification of the communities according to the physico-chemical characteristics of the water. Ten diatom assemblages have been described and this typology has been compared to some algal associa-tions defined in the literature. In natural environment, these 10 assemblages are strictly correlated with the nature of the geological substrate and the physico-chemical characteristics of the water. The physico-chemical characteristics of the water. The sensitivity of oligotrophic streams is revealed by the speedy changes in the communities following a small modification of environmental factors (sea-sonal variations or light eutrophication). (Author's abstract) W88-08873

SUBLITTORAL AND PROFUNDAL OLIGO-CHAETA FAUNA OF THE LAKE CONSTANCE (BODENSEE-OBERSEE),

Landesanstalt fuer Umweltschutz Baden-Wuert-temberg, Karlsruhe (Germany, F.R.). Inst. fuer Seenforschungs Fischereiwesen.
For primary bibliographic entry see Field 5C.

Group 2H—Lakes

NET PLANKTON AND MACROZOOBENTHOS OF THE LAKE IZRA, Slovenska Akademia Vied, Bratislava (Czechoslo-

J. Terek, J. Brazda, and K. Halatova. Biologia (Bratislava), Vol. 42, No. 2, p 127-143, February 1987. 8 fig, 6 tab, 28 ref.

Descriptors: *Phytoplankton, *Zooplankton, *Lake Izra, *Czechoslovakia, *Mountain lakes, Ecology, Slanske mountains, Zoobenthos, Biomass, Population density, Species diversity.

In 1982, in monthly intervals, essential physico-chemical properties of water, phytoplankton, zoo-plankton and zoobenthos were monitored in Lake Izra situated in the Slanske Mountains (448 m above sea level, area 3.7 ha, depth 6.5 m) in eastern Slovakia. The lake is characterized by a rich Slovakia. The lake is characterized by a rich supply of organic material that determines the majority of water properties. In general, 45 species of phytoplankton, 80 species of zooplankton with a mean abundance of 539.6/1 and a biomass of 9.4 mg/l, more than 35 species of macrozoobenthos and 10 other animals with marked vertical distribution were identified. The qualitative and quantitative composition of the macrozoobenthos was uon were identified. The qualitative and quantita-tive composition of the macrozoobenthos was markedly different between Lake Izra and Great Vihorlat Lake but the data suport previous find-ings that the zones richest in biomass are at the 4-5 m depth. (Brock-PTT) W88-08878

CHANGE IN THE QUALITIES OF WATER AND BOTTOM SEDIMENT WITH THE DE-VELOPMENT OF ANOXIC LAYER IN A STRATIFIED LAKE,

Kyoto Univ., Otsu (Japan). Otsu Hydrobiological

H. Maeda, M. Kumagai, Y. Oonishi, H. Kitada,

and A. Kawai. Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No.7, p 1281-1288, July 1987. 10 fig, 1 tab, 15 ref.

Descriptors: *Lakes, *Bottom sediments, *Hypolimnion, *Lake sediments, *Thermal stratification, *Lake Biwa, Dissolved oxygen, Ammonia, Phosphates, Iron, Sulfides, Manganese, Organic acids, Hypolimnion, Anoxic layer.

The change in the qualities of water and bottom sediment accompanied by the development of an anoxic layer in Lake Biwa was studied. A dredged water region in the southern part of Lake Biwa, Japan, was used as a model of the northern part of Japan, was used as a motor of the northern part of Lake Biwa with a fair water depth. An anoxic layer was observed after the development of strati-fication due to vertical differences in temperature in June. The accumulation of ammonia, phosphates, iron, manganese, and sulfides was observed in the hypolimnion. As a result, a considerable in the hypotiminon. As a result, a consistency amount of these chemical components was found to be liberated from bottom sediments into the bottom water. Active liberation of sulfides began not after the development of an anoxic layer but at almost the same time as the stratification. Sulfide production in the bottom sediment with a large amount of organic matter accumulation was accelamount of organic matter accumulation was accel-erated by the presence of organic acids such as formic, butyric, and lactic. The production of these acids in the bottom sediment was closely related to the supply of dissolved oxygen at the bottom sur-face, which might be governed by the vertical diffusion of lake water. (Author's abstract) W88-08886

EFFECT OF DISSOLVED OXYGEN CONCENTRATION ON THE BIOLOGICAL OXIDATION OF SULFIDE AND ELEMENTAL SULFUR BY THE A-TYPE SULFUR-TURF GROWING IN HOT SPRING EFFLUENTS, Iwate Medical Univ., Morioka (Japan). Dept. of For primary bibliographic entry see Field 2K. W88-08896

2I. Water In Plants

EFFECTS OF SOIL AND NITROGEN ON WATER USE EFFICIENCY OF TALL FESCUE

AND SWITCHGRASS UNDER HUMID CONDITIONS,

HONS, Agricultural Research Service, University Park, PA. Regional Pasture Research Lab. W. L. Stout, G. A. Jung, and J. A. Shaffer. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 429-434, March-April 1988. 2 fig. 9 tab, 17

Descriptors: *Water use efficiency, *Nitrogen, *Grasses, *Soil-water-plant relationships, *Fertilization, *Soil water, *Crop yield, Hydrology, Runoff, Rainfall, Fertilizers.

Nitrogen fertilization of semiarid grasslands interacts with available soil moisture to increase forage yields and water use efficiency of grasses. If inter-active effects of water and N can be determined active effects of water and N can be determined under humid conditions, increased production could be realized on the droughty, hill land pastures of the northeast USA. The objective of this study was to quantify the interactive effects of N fertilization and soil water availability on the yield and water use efficiency of a C3 and a C4 forage grass under humid conditions. Tall fescue and switchgrass were grown on three shale derived coils with available water holding capacities of 25 soils with available water holding capacities of 25, 15, and 5 cm. The grasses received 0, 90, and 180 kg/ha of N. The N was applied in a split application on fescue and in one application on switch-grass. Grasses were harvested at early heading and in late fall. Precipitation, temperature, and soil in late fall. Precipitation, temperature, and soil water data were recorded throughout the growing season. During years when precipitation was evenly distributed, N was the main factor controlling yields and water use efficiency, accounting for about 80% of the variation in those two parameters. When most of the precipitation occurred as large storm events or when precipitation was low or poorly distributed, soil water holding capacity was the major factor controlling yield and water use efficiency, accounting for about 40% of the variation in the yields of tall fescue and switchgrass. Over years, water loss due to deep percola-tion and/or runoff was the most important soil related factor affecting yield and water use effi-ciency. (Author's abstract) W88-07995

ROOT GROWTH IN A CLAYPAN WITH A PERENNIAL-ANNUAL ROTATION, Kansas Agricultural Experiment Station, Manhat-tan. Evaportanspiration Lab. S. J. Grecu, M. B. Kirkham, E. T. Kanemasu, D. W. Sweney, and L. R. Stone. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 488-494, March-April 1988. 10 fig, 1 tab, 25 ref.

Descriptors: *Density, *Root growth, *Claypan, *Alfalfa, *Grasses, *Clays, *Hardpan soils, *Soilwater-plant relationships, Soil water, Hydrology, Corn, Soybeans, Roots, Loam.

Drought stress occurs on claypan soils because brought stress occurs on claypan soils because they restrict root growth and water uptake. This research sought to determine if alfalfa (Medicago sativa L.) planted with fescue (Festuca arundinacea Schreb.) would decrease penetration resistance of a claypan soil enough to justify a regular rotation of claypan soil enough to justify a regular rotation of the legume-grass mixture with annual summer crops of maize (Zea mays L.) and soybean (Glycine max (L.) Merr.). The study was carried out in southeast Kansas on a Parsons silt loam (Mollic Albaqualf, fine, mixed, thermic), overlying clay (the claypan). Alfalfa + fescue were grown for 2 yr and disked. Maize or soybean then was planted on these plots. Control plots contained either maize or soybean for 3 yr. After 3 yr, penetration resistance, bulk density, soil-water content, and root length density were measured. Growing alfalfa + fescue had no effect on the penetration resistance or bulk density of the soil. At the beginning of the third year, plots previously planted with alfalfa + fescue had less water in the claypan than continuous plots of maize or soybean. Maize continuous plots of maize or soybean. Maize grown on continuous plots had more roots, was 0.3 m taller at tasseling, and had a greater yield (al-though still low due to the dry summer) than maize grown on plots previously planted with alfalfa + fescue. This increased growth was due partly to the greater amount of water available in the con-

tinuous plots. Roots of both maize and soybean penetrated the claypan to the maximum depth of observation (1.35 m from the soil surface). Root length densities in the claypan were greater for maize than for soybean. (Author's abstract) W88-0799

EFFECTS OF DROUGHT ON HOST AND ENDOPHYTE DEVELOPMENT IN MYCORRHIZAL SOYBEANS IN RELATION TO WATER USE AND PHOSPHATE UPTAKE

Agricultural Research Service, Albany, CA. West-ern Regional Research Center

G. J. Bethlenfalvay, M. S. Brown, R. N. Ames, and R. S. Thomas.

Physiologia Plantarum PHPLAI, Vol. 72, No. 3, p 565-571, March 1988. 4 fig, 6 tab, 30 ref.

Descriptors: *Soil-water-plant relationships, *My-Descriptors: "Soil-water-piant relationsnips, "My-corrhizae, "Water stress, "Water use, "Drought, "Drought resistance, "Fungi, "Soybeans, "Wilting, "Phosphorus, "Phosphates, "Plant physiology, "Plant growth, "Plant water potential, Fertiliza-tion, Fertilizers, Roots, Leaves, Soil water, Soil moisture deficiency, Biomass, Dry matter, Wilting

Soybean (Glycine max) plants were grown in pot cultures and inoculated with the vesicular-arbuscular mycorrhizal fungus Glomus mosseae or provided with phosphorus fertilizer. After an initial growth period (21 days), plants were exposed to cycles of severe, moderate, or no drought stress over a subsequent 28-day period. Dry weights of fungus-inoculated plants were greater at severe stress and smaller at no stress than those of uninoculated plants. Phosphorus fertilization was acculated plants. Phosphorus fertilization was acculated plants. Phosphorus fertilization was accurated plants. stress and smaller at no stress than those of unino-culated plants. Phosphorus fertilization was ap-plied to produce inoculated and uninoculated plants of the same size at moderate stress. Root and leaf phosphorus were higher in uninoculated plants at all stress levels. All plants were stressed to permanent wilting prior to harvest. Inoculated plants had lower soil moisture content at harvest than uninoculated plants. Colonization of roots by G. mosseae did not vary with stress, but the bio-mass and length of the extraradical mycelium was greater in severely-stressed than in non-stressed plants. Growth enhancement of inoculated plants relative to phosphorus-fertilized uninoculated plants under severe stress was attributed to inplants under severe stress was attributed to in-creased uptake of water as well as to more efficient phosphorus uptake. The ability of inoculated plants to deplete soil water to a greater extent than unino-culated plants suggests lower permanent wilting potentials attributable to fungus inoculation. (Au-thor's abstract) W88-08144

WATER RELATIONS AND MORPHOLOGICAL DEVELOPMENT OF BARE-ROOT JACK PINE AND WHITE SPRUCE SEEDLINGS: SEEDLING ESTABLISHMENT ON A BOREAL CUT-OVER SITE,

Toronto Univ. (Ontario). Faculty of Forestry For primary bibliographic entry see Field 2D. W88-08203

PROTEIN SYNTHESIS BY LAKE PLANKTON MEASURED USING IN SITU CARBON DIOX-IDE AND SULFATE ASSIMILATION,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Biology and Living Resources. For primary bibliographic entry see Field 2H. W88-08276

INFLUENCE OF LIGHT INTENSITY, LIGHT QUALITY, TEMPERATURE, AND DAY-LENGTH ON UPTAKE AND ASSIMILATION OF CARBON DIOXIDE AND SULFATE BY LAKE PLANKTON,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Biology and Living For primary bibliographic entry see Field 2H.

Erosion and Sedimentation—Group 2J

INFLUENCE OF UNDERCANOPY SPRIN-KLER AND DRIP IRRIGATION SYSTEMS ON GROWTH AND YIELD OF BANANAS (CULTI-VAR WILLIAMS) IN THE SUBTROPICS, Citizens Response Co., New York. For primary bibliographic entry see Field 3F.

USE OF NOAA-AVHRR DATA IN THE LOWER RHONE VALLEY FRANCE, Institut National de la Recherche Agronomique, Montfavet (France). Station of Bioclimatologie. For primary bibliographic entry see Field 7B. W88-08473

TRANSFORMATION OF RAINFALL ENERGY BY A TROPICAL RAIN FOREST CANOPY IN RELATION TO SOIL EROSION, Bristol Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 2J. W88-08602

INFLUENCE OF DROUGHT ON STOMATAL CONDUCTANCE AND WATER POTENTIAL OF PEACH TREES GROWING IN THE FIELD, Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosocio-logiques et Ecologiques Louis-Emberger. For primary bibliographic entry see Field 3F. W88-08627

SPECIES COMPOSITION OF PHYTO- AND ZOO-PLANKTON COMMUNITIES IN FERTILIZED AND NON-FERTILIZED PADDY FIELDS, (IN JAPANESE), Shiki High School, Saitama (Japan). For primary bibliographic entry see Field 2H. W88-08634

SEASONAL DIFFERENCES IN SPARTINA RE-COVERABLE UNDERGROUND RESERVES IN THE GREAT SIPPEWISSETT MARSH IN MAS-SACHUSETTS,

SACHUSETTS, Delaware Univ., Newark. Coll. of Marine Studies. J. L. Gallagher, and R. W. Howarth. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 3, p 313-319, September 1987. 1 fig. 3 tab, 14 ref. NOAA Sea Grant NA80-AA00106.

Descriptors: *Marshes, *Salt marshes, *Coastal marshes, *Spartina, *Plant growth, Recoverable underground reserves, Massachusetts, Delaware, Georgia, Tidal rivers.

Recoverable underground reserves were collected from cores taken from stands of three growth forms of Spartina alterniflora and one of Spartina patens in a Massachusetts salt marsh. Collections were timed to sample reserves before spring growth, following the flush of early-season growth, and following senescence in the fall. In the spring, streamside Spartina alterniflora had more recoverable underground reserves than did the short plants further back from the streams. When compared to reserves of Spartina alterniflora in back marsh stands in Delaware and Georgia, those in Massachusetts were greater. Reserves were very low during summer, but were restored by fall. Unlike Spartina alterniflora, Spartina patens recoverable underground reserves remained high during the summer. (Author's abstract) W88-08722

EFFECT OF MANGANESE-COPPER INTER-ACTIONS ON GROWTH OF A DIATOM IN WATER FROM A MANGANESE-RICH BRIT-ISH COLUMBIA FJORD, State Univ. of New York at Stony Brook. Marine Sciences Research Center.

For primary bibliographic entry see Field 2K. W88-08724

DAILY STUDY OF THE DIATOM SPRING BLOOM AT ROSCOFF (FRANCE) IN 1985: I. THE SPRING BLOOM WITHIN THE ANNUAL

Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France). A. Sournia, J.-L. Birrien, J.-L. Dauville, B. Klein, and M. Viollier. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 3, p 355-367, September 1987. 8 fig, 2 tab, 43 ref. Ifremer Contract 85-1430507.

Descriptors: "Plankton, "Phytoplankton, "Eutrophication, "Chrysophyta, "Diatoms, "Tidal effects, "Nutrients, "Cycling nutrients, "Light penetration, "Opacity, Particulate matter, Data collections, France, English Channel, Physical properties, Dissolved oxygen, Sediment load, Nitrogen compounds, Phosphorus compounds, Chlorophyll, Zooplankton, Biomass, Benthic flora, Algae, Temperate zone, Population dynamics, Plant growth.

perate zone, Population dynamics, Plant growth. The repeated occurrence of a monospecific bloom of the plankton diatom Rhizosolenia delicatula at Roscoff (western English Channel) was made the subject of an interdisciplinary research program. Samples were taken at daily intervals from April to July and at longer intervals during the remaining part of 1983. Routine physical parameters, light transmission, nutrients, dissolved oxygen, particle load, particulate nitrogen and phosphorus, chlorophyll content, phytoplankton counting, and zooplankton biomass were measured as a basis for more specific studies (to follow as subsequent papers in this series). The area is characterized by: high tidal range, permanent mixing throughout the year, low attenuation coefficients, moderate nutrient supply, and the dominance of benthic algae over phytoplankton. The spring bloom is significantly delayed with respect to the usual model for the temperate seas. Tidal cycles are expected to exert the main influence on bloom dynamics at the time scale of phytoplankton growth. (Author's abstract) stract) W88-08725

CHANGES IN CARBON AND HYDROGEN STABLE ISOTOPE RATIOS OF MACROAL-GAE AND SEAGRASS DURING DECOMPOSI-TION,

nia Univ., Hobart (Australia). Dept. of Zool-

ogy. For primary bibliographic entry see Field 2K. W88-08746

PLANT POPULATION, RAINFALL, AND SOR-GHUM PRODUCTION IN BOTSWANA: I. RE-SULTS OF EXPERIMENT STATION TRIALS, Agricultural Research Station, Gaborone (Botswana). Dryland Farming Research Scheme. For primary bibliographic entry see Field 3F. W88-08747

PLANT POPULATION, RAINFALL, AND SOR-GHUM PRODUCTION IN BOTSWANA: II, DE-VELOPMENT OF FARMER RECOMMENDA TIONS.

Agricultural Research Station, Gaborone (Botswa-na). Dryland Farming Research Scheme. For primary bibliographic entry see Field 3F. W88-08748

SUMMER EVOLUTION OF TURBIDITY IN LAKE NEUCHATEL. (EVOLUTION ESTIVALE DE LA TURBIDITE DANS LE LAC DE NEUCHATEL),

Neuchatel Univ. (Switzerland). Lab. de Mineralo-gie, Petrographie et Geochimie. For primary bibliographic entry see Field 2H. W88-08823

NUTRIENT CONTROL IN THROUGHFALL WATERS OF FOREST ECOSYSTEMS, Polish Academy of Sciences, Lomianki. Inst. Eko-

logii.
A. Stachurski.
Ekologia Polska ELPLBS, Vol. 35, No. 1, p 3-69, 1987. 30 fig, 16 tab, 93 ref.

Descriptors: *Throughfall, *Rainfall, *Forests, *Ecosystems, *Plant growth, *Absorption, *Cycling nutrients, Heavy metals, Ions.

Multiple regression was used for describing the processes that determine nutrient budgets in throughfall (N, Ca, K, Na, Fe, Mn, Zn, Cu). The throughfall (N, Ca, K, Na, Fe, Mn, Zn, Cu). The commonly occurring absorption process have been found to cause nutrient-impoverishment of throughfall. On the other hand, throughfall waters become enriched due to ion elimination by plants, connected with the soil fertility (Ca, Mg, Mn), ionic exchange: Na, K, Zn with the NH4 ion in the canopy, and the activity of phytophages which have a particularly strong intensifying influence on the return of the Na, K, Zn ions to the soil. (Author's abstract) (Author's abstract) W88-08840

GROWTH RESPONSES OF BIRCH AND SITKA SPRUCE EXPOSED TO ACIDIFIED

Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station. For primary bibliographic entry see Field 5C. W88-0893

SIMULTANEOUS DETERMINATION SIMULIANEOUS DETERMINATION OF URONIC ACIDS AND ALDOSES IN PLANK-TON, PLANT TISSUES, AND SEDIMENT BY CAPILLARY GAS CHROMATOGRAPHY OF N-HEXYLALDONAMIDE AND ALDITOL ACE-

Washington Univ., Seattle, School of Oceanogra-

phy.
J. S. Walters, and J. I. Hedges.
Analytical Chemistry ANCHAM, Vol. 60, No. 10, p 988-994, May 15, 1988. 3 fig, 6 tab, 17 ref.

Descriptors: *Chemical analysis, *Plankton, *Kelps, *Marine sediments, Plant physiology, *Gas chromatography, *Sediments, Uronic acids,

A method for simultaneous extraction and quantifi-cation of aldoses and uronic acids from natural samples combines a new hydrolysis technique em-ploying trifluoroacetic acid at 135 C with a reproducible derivatization producing N-alkylaldona-mide and alditol acetates that are completely sepa-rated by capillary gas chromatography. Optimal hydrolysis conditions for rapid, maximum recoveries are presented. Quantification is based on tests of polymer hydrolysis and monomer derivatization recovery efficiencies. The method was applied to plankton, kelp and reducing coastal marine sedi-ments. The results indicate that kelp is as much as 40% (by weight) mannuronic acid and that the sediments contain amounts of galacturonic and glu-curonic acids comparable to those of the neutral sugars. (Brock-PTT) W85-08898

2J. Erosion and Sedimentation

FEASIBILITY OF USING SEQUENTIAL EX-TRACTION TECHNIQUES FOR ARSENIC AND SELENIUM IN SOILS AND SEDIMENTS, Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W88-07994

SLUSHFLOWS IN A SUBARCTIC ENVIRON-MENT, KILPISJARVI, FINNISH LAPLAND, Southampton Univ. (England). For primary bibliographic entry see Field 2C. W88-08027

SEDIMENT NUTRIENT FLUXES IN A TIDAL FRESHWATER EMBAYMENT,
Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W88-08030

VARIABILITY OF SOIL WATER PROPERTIES AND CROP YIELD IN A SLOPED WATER-SHED,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab. For primary bibliographic entry see Field 2G.

Group 2J-Erosion and Sedimentation

W88_08034

SEDIMENT AND WATER YIELDS FROM MANAGED FORESTS ON FLAT COASTAL PLAIN SITES,

Arkansas Univ. at Monticello. Dept. of Forest

R. S. Beasley, and A. B. Granillo. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 361-366, April 1988. 1 fig. 4 tab, 18 ref.

Descriptors: *Forest management, *Coastal plains, *Sediment yield, *Sediments, *Water yield, Arkansas, Watersheds, Hydrology, Forests, Forest watersheds, Clear-cutting.

Sediment losses and water yields were measured for five years on nine forested watersheds in the Gulf Coastal Plain of Arkansas. After one year of pretreatment measurements, three watersheds were clearcut and mechanically site prepared, three were selectively harvested, and three control watersheds were left undisturbed. Sediment losses and water yields were similar for the selectively harvested and control watersheds during all four post-reatment wers. However, clearcuting with metreatment years. However, clearcutting with mechanical site preparation significantly increased sediment losses and water yields above levels measured on other watersheds. Increased sediment measured on other watersheds. Increased sediment losses persisted for two years, while water yields increased for one year. Although sediment losses from clearcutting were greater than for other treatments, actual losses averaged only 264 kg/ha and 63 kg/ha for the first and second post-treatment years, respectively. The relatively low sediment losses are attributed to the flat terrain and the relatively low flow discharge rates that typify these sites. (Author's abstract) W88-08043

MODEL PREDICTIONS OF WATERSHED EROSION COMPONENTS, Oak Ridge National Lab., TN. Engineering Phys-

D. M. Hetrick, and C. C. Travis. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 413-419, April 1988. 6 tab, 23 ref. EPA Inter-agency agreement No. DW 89931378-01-0 and agency agreement No. DW 89931. DOE Contract DE-AC05-840R21400.

Descriptors: *Soil erosion, *Erosion, *Surface runoff, *Watersheds, SESOIL/EROS, Sediment yield, Model studies, Mathematical studies, Predic-tion, Runoff, Rainfall-runoff relationships, Storms.

Model predictions for surface runoff and sediment yield from the coupled SESOIL/EROS soil com-partment model are compared with empirical measurements from three watersheds. The model is summarized and descriptions are given for the two cornfield watersheds and one grassland watershed used in the analysis. Overall, SESOIL/EROS model predictions on an annual basis are in fair to good agreement with observed data from the three watersheds. For long-term analyses, the erosion component of the model is adequate for screeninglevel applications where order-of-magnitude differ-ences between predictions and observations are accepted. However, short-term predictions were shown to be quite different than observations, esshown to be quite different than observations, especially in months where most of the surface runoff came from one of several storms. It is clear that SESOIL/EROS would perform better if actual data for each storm were input to the EROS component. Also, the sensitivity of the parameter MTR, the mean time of each rainfall event for each month, is apparent in this analysis. Where possible, MTR should be optimized for this model so that the predictions of surface runoff would compare well with measurements. (Alexander-PTT) W88-08049

SIZE DISTRIBUTION OF ERODED SEDI-MENT FROM TWO TILLAGE SYSTEMS, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Agricultural Engineering. M. M. Deizman, S. Mostaghimi, V. O. Shanholtz, and J. K. Mitchell.

Society of Agricultural Engineers

TAAEAJ, Vol. 30, No. 6, p 1642-1647, November-December 1987. 2 fig, 6 tab, 23 ref.

Descriptors: *Soil erosion, *Cultivation, *Particle size, *Rainfall, *Runoff, *Erosion, *Sediments, *Tillage effects, *Simulated rainfall, Rainfall simulators, Mathematical studies, Soil compaction, Pre-

diction, Equations.

A rainfall simulator was used to study the effect of tillage on the physical characteristics of sediment from cropland. Rainfall was applied to 12 experimental field plots, each 0.01 ha in size. The plots were divided into conventional and no-tillage systems. Runoff samples were collected from the base of each plot and analyzed for sediment concentration and aggregate and primary particle size distributions. Sediment aggregates were finer than the aggregates found in the matrix soil and were enriched with primary clay particles. The aggregates size of the eroded material increased as rainfall continued. No-till was found to be effective in reducing runoff and sediment losses. Sediment aggregates from no-till plots were coarser than those from conventional tillage plots. The sediment from no-till plots contained higher percentages of gravel, sand, and clay primary particles. Empirical equations are presented for use in predicting the size distribution of eroded material from a silt loam soil. (Author's abstract) soil. (Author's abstract) W88-08054

VERIFICATION OF A MODEL PREDICTING SEDIMENT LEVEL IN SUBSURFACE DRAINS,

SEDIMENT LEVEL IN SUBSURFACE DRAINS, Laval Univ., Quebec. Dept. of Soil Science. J. Gallichand, and R. Lagace. American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1648-1652, November-December 1987. 6 fig. 3 tab, 6 ref.

Descriptors: *Sediments, *Subsurface drains, *Model studies, *Prediction, Soil mechanics, Mathematical studies, Equations, Soil types, Particle size, Permeameters, Sands.

An arctangent sigmoid model to predict sediment level in perforated subsurface drains is compared to results from five different sets of data found in the literature. The experiments reported in the literature ranged from the study of bridging with dry sand to a field investigation using corrugated plastic drains. Most of the data analyzed with the plastic drains. Most of the data analyzed with the arctangent signoid model yielded a coefficient of determination greater than 0.90 when each soil was considered individually. For experiments with dry sands in a permeameter, the grouping of the sediment level from different soils was made possible by the use of the D60 (sieve size) only. For sands in a permeameter with downward flow, the use of both the particle size and the coefficient of uniformity (CU) was necessary in order to obtain results with a high correlation. For a field experiment, an R squared of 0.844 was reached using the particle size and CU. (Author's abstract)

SPATIAL TRENDS AND VARIABILITY OF SOIL PROPERTIES AND CROP YIELD IN A SMALL WATERSHED,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
R. D. Williams, L. R. Ahuja, J. W. Naney, J. D. Ross, and B. B. Barnes.
American Society of Agricultural Engineers

Ross, and B. Darnes.

American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1653-1660, November-December 1987. 8 fig, 4 tab, 25 ref.

Descriptors: *Soil erosion, *Erosion, *Sediments, *Soil properties, *Crop yield, *Model studies, *Spatial distribution, Least squares method, Vario-grams, Variation coefficient, Soil water, Matheatical studies, Sorghum

The long term effects of sediment redistribution due to the erosion-deposition process on soil prop-erties and crop yield in a small watershed were evaluated by an analysis of two-dimensional spatial trends, correlation structure of variability, and the interrelationship of selected topsoil properties and grain sorghum dry weight. Measurements were made in a 10 m, two dimensional grid of 108

points, which were supplemented by measurements of both top- and sub-soil properties from a 21 point line transect down the center of the watershed. Crop dry weight, soil bulk density, and soil water storage were measured for two growing seasons. Among the soil properties measured on the grid, sand content had the highest coefficient of variation, followed by clay content and soil water storage. The coefficient of variation of grain sorghum age. The coefficient of variation of grain sorghum dry weight was greater than those of the soil properties. There were significant two-dimension-al, curvilinear trends for all properties, which were represented by least-square parabolic surfaces. Al-though silt and clay contents increased, sand con-tent decreased downslope. Grain sorghum dry weight in both years increased downslope, and was higher on both sides than in the middle of the field. All variograms had a large nugget effect. The variograms for texture components showed a weak correlation structure, with a range between 30 m variograms for texture components showed a weak correlation structure, with a range between 30 m and 40 m. In both years, the semivariograms for soil bulk density and water storage did not clearly indicate a spatial structure. Texture and available water in the top- and sub-soil explained a large percentage of the trend (increase) and variation of grain sorghum dry weight downslope. In all cases, the dry weight was correlated positively with sind content and negatively with sand content. The topsoil properties were relatively more important for yield under suboptimal growing conditions, while the subsoil was a limiting factor for yield under normal conditions. (Author's abstract) W88-08056

SIMULATING SUBSURFACE DRAINAGE IN THE LOWER MISSISSIPPI VALLEY WITH DRAINMOD,

Agricultural Research Service, Baton Rouge, LA. Soil and Water Pollution Research Unit. For primary bibliographic entry see Field 4B. W88-08059

PREDICTING INFILTRATION PARAMETERS FOR A ROAD SEDIMENT MODEL, Agricultural Research Service, Pullman, WA.

For primary bibliographic entry see Field 5B. W88-08062

PARTITIONING OF HEAVY METALS INTO SELECTIVE CHEMICAL FRACTIONS IN SEDIMENTS FROM RIVERS IN NORTHERN GREECE.

Thessaloniki Univ., Salonika (Greece). Environ-mental Pollution Control Lab. For primary bibliographic entry see Field 5B. W88-08073

SUBMERGED AQUATIC MACROPHYTE BIO-MASS IN RELATION TO SEDIMENT CHARACTERISTICS IN TEN TEMPERATE LAKES, McGill Univ., Montreal (Quebec). Dept. of Biol-

For primary bibliographic entry see Field 2H.

ZOOPLANKTON FEEDING RATES IN RELA-TION TO SUSPENDED SEDIMENT CONTENT: POTENTIAL INFLUENCES ON COMMUNITY STRUCTURE IN A TURBID RESERVOIR,

Rhodes Univ., Graham of Freshwater Studies. stown (South Africa). Inst.

For primary bibliographic entry see Field 2H. W88-08077

LAKE SEDIMENT MICROLAMINAE AND ANNUAL MORTALITIES OF PHOTOSYNTHETIC BACTERIA IN AN OLIGOMICTIC

Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences. M. Dickman

Freshwater Biology FWBLAB, Vol. 18, No. 1, p 151-164, August 1987. 6 fig, 2 tab, 36 ref, append. Descriptors: *Lake sediments, *Sedimentation, *Microlamina formation, *Oligomictic lakes, *Pho-

Erosion and Sedimentation—Group 2J

tosynthetic bacteria, Sediments, Zaca Lake, California, Cores, Stratigraphy, Bacteria, Chemocline, Sulfur bacteria, Anaerobic bacteria.

A novel mechanism of microlamina formation in A nover mechanism of meronamia formation in oligomictic lakes is proposed. During spring and summer in Zaca Lake, an oligomictic lake in Santa Barbara, California, a light-colored microlamina Barbara, California, a light-colored microlamina was formed. During winter, a mass mortality of sulfur-rich phototrophic bacteria occurred following the ventilation of the chemocline or the overturn of the lake. When this occurs, oxygen is introduced into the chemocline killing most of the anaerobic bacteria. When these sulfur-laden bacteria die and settle to the bottom of the lake, they form a black microlamina which is rich in ferrous monosulfides. The varved stratigraphy of the Zaca Lake sediment core presented an opportunity to Lake sediment core presented an opportunity to correlate stratigraphic events in the lake's varved sediments with events reported for its catchment over the last 200 years. Colonization by Europeans dates back to the 1760s, making this one of the best-documented histories for a small lake in North oest-documented instories for a small take in North America. A number of events were correlated with stratigraphic information from the lake's varved cores. Eutrophic diatom indicator species disappear downcore, where they are replaced by mesonal oligotrophic indicators. In addition, pollen from exotic trees planted in the lake's catchment appears as specific core depths associated with their pollen production stage. (Author's abstract) W88-08101

LATE HOLOCENE FLOODING IN THE ECUA-DORIAN RAIN FOREST, Ohio State Univ., Columbus. Dept. of Zoology. For primary bibliographic entry see Field 2E. W88-08107

SPATIAL DISTRIBUTION OF TRICHOPTERA LARVAE IN THE SEDIMENTS OF AN AUS-TRIAN MOUNTAIN BROOK,

Vienna Univ. (Austria). Zoologisches Inst. For primary bibliographic entry see Field 2H. W88-08109

SPATIAL DISTRIBUTION OF DENITRIFYING ACTIVITY IN A STREAM DRAINING AN AGRICULTURAL CATCHMENT,

Oxford Univ. (England). Dept. of Plant Sciences. For primary bibliographic entry see Field 5B. W88-08112

HYDRAULIC AND SOIL MECHANICAL ASPECTS OF RILL GENERATION ON AGRICULTURAL SOILS,

Katholieke Univ. Leuven (Belgium). Lab. voor Experimentele Geomorfologie.

G. Rauws, and G. Govers.

Journal of Soil Science JSSCAH, Vol. 39, No. 1, p. 111-124, March 1988.

Descriptors: *Overland flow, *Rills, *Rill erosion, *Agricultural runoff, *Soil erosion, *Soil mechan-ics, *Soil dynamics, *Hydraulic properties, Rain-fall, Rainfall impact, Sediment erosion, Soil types,

An attempt is made, using literature data, to clarify the relationship between the detachment capacity of overland flow and its hydraulic characteristics. Attention is paid to the influence of sediment properties and rainfall. Using these relationships and the concept of effective shear velocity, it was possible to establish a relationship for rill prediction which covers a variety of soils and a wide range of field conditions. Raindrop impacts do not seem to have an important influence on rill generation on cohesive materials. (Author's abstract) An attempt is made, using literature data, to clarify

COASTAL WATER QUALITY AND ITS EFFECT ON BEACH EROSION: A CASE STUDY

Howard Univ., Washington, DC. For primary bibliographic entry see Field 5C. W88-08141

DISTRIBUTION OF ORGANIC MICROPOL-LUTANTS IN DIFFERENT SIZE FRACTIONS OF SEDIMENT AND SUSPENDED SOLID PARTICLES OF THE RIVER ROTMAIN, Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer

Hydrologie For primary bibliographic entry see Field 5B. W88-08166

FLUIDIZATION OF MUD IN ESTUARIES, Australian Inst. of Marine Sciences, Townsville. E. Wolanski, J. Chappell, P. Ridd, and R.

Vertessy. Journal of Geophysical Research JGRCEY, Vol. 93, No. C3, p 2351-2361, March 15, 1988. 14 fig, 37

Descriptors: *Estuaries, *Sedimentation, *Mud, *Tidal estuaries, *Suspended sediments, Mudwater interfaces, Suspended sediment concentrations, Australia, South Alligator River, Tidal currents, Water currents, Richardson number.

The South Alligator River, located in the Northern Territory of Australia, is a macrotidal estuary with suspended sediment concentration values reaching 10 grams per liter. In the dry season of September 1986, the estuary was well mixed in temperature and salinity. While the vertical gradients in suspended sediment concentration were small at flood tides, for most of the ebb tide duration a lutocline separated a clear unpreclevel duration a lutocline separated a clear upper level from an extremely turbid bottom layer. The tidal from an extremely turbid bottom layer. The tidal evolution of the suspended sediment concentration is consistent with that computed by a numerical model based on the equation of conservation of mass suspended sediment. In this model, sediment is entrained from the bottom and mixed vertically upward by eddy diffusion. But, through a Richardson number dependence, sediment-induced buoyancy effects inhibit vertical mixing. The final depth of the turbid layer can be readily estimated analytically as a result of a balance between the rate of kinetic energy input and the buoyancy flux determined and the buoyancy flux determine catty as a result of a balance between the rate of kinetic energy input and the buoyancy flux deter-mined by the particle fall velocity. The presence of a lutocline helps form mud banks on the inner side of a meander. (Author's abstract) W88-08243

TEMPORAL, SPATIAL AND SIZE VARIATION IN THE SEDIMENT TRANSPORT IN THE KRISHNA RIVER BASIN, INDIA, Jawaharlal Nehru Univ., New Delhi (India).

ARISHNA RIVER BASIN, INDIA, Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences. R. Ramesh, and V. Subramanian. Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 53-65, March 15 1988. 9 fig, 1 tab, 18 ref.

Descriptors: *Sediment transport, *Erosion, *Dam effects, Wind, Monsoons, Distribution, Krishna River, Bay of Bengal, India, Rivers.

The total sediment transport of the Krishna River to the Bay of Bengal is estimated to be 411,000 tons/yr. The sediment load decreases sharply from 6,772,000 tons/yr from the upstream region (Morvakonda) to 411,000 tons/yr at the river mouth (Vijayawada). The depletion of sediment supply in the river mouth and lack of uniformity in sediment transport within the basin is mainly due to several human activities such as dams cropping etc. The transport within the basin is mainly due to several human activities such as dams, cropping, etc. This has been substantiated by the temporal and spatial variation of the suspended sediments based on fourteen years data (1971-84). One of the tributaries of the Krishna, the Bhima River, is the main sediment contributor to the Krishna with an average annual sediment transport of 2,591,000 tons and sediment concentration of 2070 mg/l. The bulk of sediment transport (>95%) takes place in the monsoon period. Erosion rate shows no systematic relationship either spatially or temporarily. The total sediment erosion of the Krishna is estimated to be 16 tons/km/yr. Rates of erosion calculated for various subbasins indicate that smaller basins for various subbasins indicate that smaller basins erode more rapidly than larger basins. The particle size distribution of the suspended sediments were correlated with the mean monthly sediment transportation to evaluate the downstream and temporal variation of grain size with sediment transport. At the river mouth, enormous amounts of fine particles (1-10 micrometers) add to the monthly sedi-ment load of the river. (Author's abstract)

W88-08327

MECHANICS OF INCOMPRESSIBLE MULTI-

PHASE SUSPENSIONS, Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Industrial Engineering. For primary bibliographic entry see Field 8B. W88-08338

SOIL EROSION AND WATER TREATMENT

Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology. For primary bibliographic entry see Field 5F.

INTENSIVE CROPPING SEQUENCES TO SUSTAIN CONSERVATION TILLAGE FOR EROSION CONTROL,

Agricultura! Research Service, Watkinsville, GA. G. W. Langdale, and R. L. Wilson. Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 5, p 352-355, September-October 1987. 5 tab, 30 ref.

Descriptors: *Erosion control, *Soil erosion, *Soil conservation, *Agriculture, *Crop production, Tillage, Crop rotation, Watersheds, Soybeans, Sorghum, Wheat.

High-frequency cropping and tillage systems were studied on both watersheds and randomized plots to find alternative ways of enhancing long-term conservation management. Ten soybean and grain sorghum cropping sequences following wheat harvest were used with each of two conservation tillages, coulter in-row chisel (MT) and coulter (NT), and one conventional tillage (CT). All of these double-crop tillage systems produced up to 12.5 Mg/ha of crop residue, provided annual aver-12.5 Mg/ha of crop residue, provided annual average Cx P factors were < or = 0.05, and eliminated any soil erosion hazard. Grain sorghum responded significantly to Mr. Tillage, yielding an average of 0.31 and 0.50 Mg/ha more grain than the average for the CT (4.58 Mg/ha) and NT (4.39 Mg/ha) treatments, respectively. Soybeans responded significantly to more frequent rotations (1:1 and 2:1) with grain sorghum, yielding up to 28 Mg/ha more than cross produced by continuous. (1:1 and 2:1) with grain sorghum, yielding up to 0.28 Mg/ha more than crops produced by continuous cropping (2.04 Mg/ha). Wheat yields following grain sorghum were significantly lower at times than those following soybeans, averaging 3.54 and 3.68 Mg/ha, respectively. Intensive crop rotations appear essential to sustain long-term conservation tillage systems that control soil erosion in the Southern Piedmont. (Author's abstract) W88-08382

EROSION AND SEDIMENT POLLUTION CONTROL.

R. P. Beasley, J. M. Gregory, and T. R. McCarty. Second edition. Iowa State University Press, Ames. 1984. 354 p.

Descriptors: *Erosion, *Sedimentation, *Water quality control, Runoff, Tillage, Forecasting, Flow patterns, Economic aspects, Agriculture.

In this second edition revisions have been made to In this second edition revisions have been made to keep up with technologies such as improvements in weed and insect control with chemicals, which allows for less tillage, better machines for tilling and planting crops in residue; and development of small computers and calculators to evaluate equa-tions for decision making. While computer pro-grams are not included, equations for tables and figures are provided where possible to facilitate calculations. Chapter 2 includes a section on pollu-tion from aericultural chemicals. Chapter 4 tion from agricultural chemicals. Chapter 4 in-cludes new procedures for predicting the effects of tillage and cover on water erosion. Chapter 5 discusses runoff prediction with the rational method as well as the Beasley method for predictions outside the United States. Chapter 6 contains a procedure for exact solutions for trapezoidal waterways and an update on underground outlet design. Finally, Chapter 7 presents material on the

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economics of alternative systems as well as a simple detailed example. (Lantz-PTT) W88-08505

THREE SIMPLE MODELS OF WAVE SEDI-MENT TRANSPORT, New York State Div. of Criminal Justice Services,

Albany. P. Nielsen

Coastal Engineering COENDE, Vol. 12, No. 1, p 43-62, March 1988. 7 fig, 23 ref, 1 append.

Descriptors: *Waves, *Sediment transport, *Model studies, Sea level, Water level, Shoreline development, Sediment.

The process of sediment transport by nonbreaking waves over horizontal, rippled beds is presented by three different models which are evaluated through comparison with wave flume data. The conclusion from this testing is 'the simpler the better'. It is shown that the process in question can in fact be modelled adequately without quantitative consideration of the suspended sediment distribution. Only a reference average concentration at bution. Only a reference average concentration at the bed is needed. On the other hand, classical diffusion models severely underpredict the transamusion modes severely underpredict the unis-port of coarse sand in suspension because the proc-ess is much more organized than diffusion. The possibility of adapting the models to conditions involving sheet flow and/or breaking waves is discussed. (Author's abstract) W88-08547

GLOBAL TRENDS IN THE NATURE OF OR-GANIC MATTER IN RIVER SUSPENSIONS, Hamburg Univ. (Germany, F.R.). Geologisch-Pa-laeontologisches Inst. und Museum. For primary bibliographic entry see Field 2E. W88-08559

SEDIMENT, EROSION AND WATER INTAKE IN FURROWS, Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. M. J. Brown, W. D. Kemper, T. J. Trout, and A. S. Humpherys. Irrigation Science IRSCD2, Vol. 9, No. 1, p 45-55, 1988. 8 fig, 7 ref.

Descriptors: *Furrow irrigation, *Erosion, *Irrigation water, *Irrigation effects, *Irrigation engineering, Agriculture, Flow rates, Irrigation, Sediments.

Observations and studies were conducted on the origin and destination of sediment in irrigation water, and the effects of sediment adsorbed on the wetted perimeter of furrows on water intake and erosion. Fine sediment adsorbed on the perimeter erosion. Fine segment adsorbed on the perimeter reduced intake increased soil water tension which was the primary mechanism holding the sediment on the perimeter. This self enhancing effect causes this thin seal to decrease erosion and intake rates. In contrast, removal of a few square centimeters of this seal by chance events after water velocities and shear forces have increased often causes re-duced tensions, exfoliation of the surface seal and erosion pits which develop into head cuts. (Au-thor's abstract) thor's al stract) W88-08592

TRANSFORMATION OF RAINFALL ENERGY BY A TROPICAL RAIN FOREST CANOPY IN RELATION TO SOIL EROSION,

Bristol Univ. (England). Dept. of Geography J. Brandt.

Journal of Biogeography JBIODN, Vol. 15, No. 1, p 41-48, January 1988. 2 fig, 2 tab, 32 ref. NERC Grant No. GT4/82/AAPS/59.

Descriptors: *Canopy, *Throughfall, *Rainfall in-tensity, *Rain forests, *Soil erosion, *Energy trans-formation, *Tropical regions, Erosion, Splash, Rainfall, Storms, Energy, Kinetics, Rain gages,

The extent to which a tree canopy changes the kinetic energy of rain falling through it and there-by changes the potential for the initiation of soil

erosion by splash below the canopy is examined. The kinetic energy of rain or throughfall depends on the depth of water, drop-size distribution and the canopy height. Comparisons have been made for individual storms in tropical rain forest because of the comparison of the canopy of the comparison of tween rain falling in an open space, rain folialing through a single-layered high canopy and a multi-layered low canopy. At frequent intervals through each storm, measurements were made of the droplayered low canopy. At frequent intervals through each storm, measurements were made of the dropsize distribution using the paper staining technique. Depth was measured at in all three sites by rain gauges and a grid of splash cups surrounded by a uniform area of sand measured the splash. The depth of water reaching the ground as throughfall was 71% of rainfall under the single canopy, but 28% under the multiple canopy. For storms equal to or greater than 2.83 mm the single canopy increased the total kinetic energy of the storm up to 1.84 times that of the rainfall. The energy change by the multiple canopy varied between 0.03 and 0.66 times that of the rainfall. The canopies changed the kinetic energy/mm/sq m of the rainfall by altering both the drop-size distribution and velocity, from 18.19 J/mm/sq m for rainfall to 31.83 J/mm/sq m and 22.09 J/mm/sq m under the single and multiple canopies respectively. Under the multiple canopy splash was reduced to a minimum of 0.4 times splash in the open but under the single canopy it was increased up to 6.65 times. (Author's abstract)

PLANNING THE USEFUL LIFE OF A RESER-

Poetroit Water and Sewerage Dept., MI. For primary bibliographic entry see Field 8A. W88-08617

STABLE WIDTH AND DEPTH OF STRAIGHT GRAVEL RIVERS WITH HETEROGENEOUS

Saitama Univ., Urawa (Japan). Dept. of Founda-tion Engineering. For primary bibliographic entry see Field 2E. W88-08664

DISTRIBUTION OF NITROGEN SPECIES AND ADSORPTION OF AMMONIUM IN SEDIMENTS FROM THE TIDAL POTOMAC

RIVER AND ESTUARY, Geological Survey, Reston, VA. For primary bibliographic entry see Field 2L. W88-08709

RELATIONSHIP BETWEEN LIGHT ATTENU-

RELATIONSHIP BETWEEN LIGHT ATTENU-ATION AND PARTICLE CHARACTERISTICS IN A TURBID ESTUARY, Maine State Dept. of Marine Resources, West Boothbay Harbor. D. E. Campbell, and R. W. Spinrad. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 1, p 53-65, July 1987. 2 fig, 7 tab, 31 ref. NSF Contract EXP8011448.

Descriptors: *Sediments, *Suspended sediments, *Particulate matter, *Particle size, *Turbidity, *Optical properties, *Light penetration, *Estuaries, Chesapeake Bay, Seston, Surface water, Opacity, Bottom water, Regression analysis.

In extremely turbid estuarine waters (seston concentration < 250 microns in size was > 65 mg/l) the beam attenuation coefficient, c, is well correlatthe beam attenuation coefficient, c, is well correlated with the smaller optically-active mass or volume concentration of seston < 100 microns in size. However, c is a poor indicator of the total seston < 250 microns in size which includes large, heavy, optically inactive particles. Two distinct particle size distributions were present: one of mean slope -3.08 associated with the surface or river waters, and a second of mean slope -2.28 associated with the bottom waters. In samples with the same particle size distribution, PSD, c was an approximately linear function of the seston concentration < 100 microns in size. These seston concentrations ranged from 30 to 74 mg/l. The suspended matter was highly aggregated (> -70% of the volume). Multiple linear-regression models for c in terms of several particle parameters indicated

that the volume mean of the PSD, an aggregation index, may help explain variation in the c vs. concentration relationship for known slopes of the PSD. (Author's abstract)

WETLAND LOSS AND THE SUBDELTA LIFE

North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.

Marine Sciences, J. T. Wells, and J. M. Coleman. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 1, p 111-125, July 1987. 9 fig. 1 tab, 22 ref. U.S. Army Corps of Engineers Waterways Experiment Station Contract DACW39-80-C-0082.

Descriptors: *Sedimentation, *Deposition, *Deltas, *Sediment erosion, *Wetlands, *Coastal marshes, *Mississippi River, Levees, Natural levees, Channels, Sediment transport, Bays, Sediment discharge, Continental shelf, Maps, Aerial photogra-

The rapid deterioration of marsh habitat observed during recent years in the Mississippi River Delta is a consequence, at least in part, of the natural life cycle of subdeltas. With life spans typically less than 200 years, subdeltas, or bay-fill deposits, are scaled-down versions of major delta lobes, yet provide, through pulses of sediment, nearly all the subaerial land in an active delta. Using maps, charts, and aerial photographs, curves were constructed for rates of change in land area, sediment volume, and linear progradation in the four subdeltas that have formed on the modern Mississippi River Delta since the first accurate survey in 1838. Results indicate that each subdelta (1) lasted for approximately 115-175 years, (2) included periods of both growth and deterioration, (3) was initiated by a crevasse or breast in the natural leves existent. of both growth and deterioration, (3) was initiated by a crevasse or break in the natural levee system, (4) showed linear advancement and volumetric growth during subaerial deterioration, and (5) disgrowth during subaerial deterioration, and (5) dis-played a new pulse of subaerial growth during the high-discharge decade of the 1970s. Contrary to popular accounts, demise of the Mississippi River Delta through deterioration of its subdeltas is not a result of the construction of artificial levees up-stream or discharge of sediment off the continental shelf edge. Rather, it is attributable to a substantial decrease and fining of sediments being transported downstream to depositional sites within a delta that has developed, through natural processes, a com-plex and inefficient channel network for delivering these sediments. (Author's abstract) these sedim W88-08713 ents. (Author's abstract)

FAUNAL CHARACTERISTICS AND SEDI-MENT ACCUMULATION PROCESSES IN THE

JAMES RIVER ESTUARY,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W88-08717

REJUVENATED MARSH AND BAY-BOTTOM ACCRETION ON THE RAPIDLY SUBSIDING COASTAL PLAIN OF U.S. GULF COAST: A SECOND-ORDER EFFECT OF THE EMERGING ATCHAFALAYA DELTA, Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments.

R. D. DeLaune, C. J. Smith, W. H. Patrick, and H.

H. Roberts. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 4, p 381-389, October 1987. 4 fig, 2 tab, 18 ref.

Descriptors: "Sedimentation, "Bottom sediments, "Accretion, "Deltas, "Subsidence, "Coastal plains, "Wetlands, "Coastal marshes, "Bays, Degradation, Cesium, Lead, Radioactive dating, Nutrients, Aquatic productivity, Louisiana, Atchafalaya River, Mississippi River.

Sedimentation processes in marshes and bays under the influence of the emerging Atchafalaya delta are described. The Atchafalaya delta is a major geo-logical event in the Holocene history of the Missis-sippi River delta system because it represents the initial stages of a new delta cycle. The delta has

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resulted from the capture of the Mississippi River flow by the hydraulically more efficient Atchafalaya River. Using Cs-137 and Pb-210 dating techniques, maximum sedimentation of delta-flanking environments was found to occur in the bay bottoms and marshes closest to the emerging delta. Marshes directly under the influence of the emerging delta were accreting at rates as great as 1.4 cm/yr with appreciable mineral sediment inputs. In addition to increasing shoreline progradation, the added sediment is providing nutrients for increased net plant productivity which provides the organic source needed for vertical marsh accretion. Results show that the major area of coastal progradation will be in the immediate vicinity of the delta and along down-drift coasts. Updriff marshes (East Terrebonne marshes) away from the delta are accreting at a slower rate with smaller mineral accidement input and a larger percentage of organic creting at a slower rate with smaller mineral sedi-ment input and a larger percentage of organic material. These marshes are likely to continue ex-periencing rapid rates of deterioration. (Author's abstract) W88-08727

CHEMISTRY OF MODERN SEDIMENTS IN A HYPERSALINE LAGOON, NORTH OF JEDDAH, RED SEA, Alexandria Univ. (Egypt). Dept. of Oceanography. For primary bibliographic entry see Field 2K. W88-08731

SUSPENDED SEDIMENT FLUCTUATIONS IN THE TAGUS ESTUARY ON SEMI-DIURNAL AND FORTNIGHTLY TIME SCALES, Instituto Nacional de Investigação des Pescas, Lisbon (Portugal).
For primary bibliographic entry see Field 2L.
W88-08732

MEASUREMENT OF VOLATILE FATTY ACIDS IN PORE WATER FROM MARINE SEDIMENTS BY HPLC, Scottish Marine Biological Association, Oban. For primary bibliographic entry see Field 5A. W88-08736

SEDIMENT DYNAMICS AND DEPOSITION IN A RETREATING COASTAL SALT MARSH, Manchester Univ. (England). Dept. of Geography. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 1, p 67-79, January 1988. 6 fig, 1 tab,

Descriptors: *Sediments, *Sedimentation, *Sediment transport, *Deposition, *Accretion, *Erosion, *Wetlands, *Coastal marshes, *Salt marshes, Sea level, Marsh plants, Tides, Aerial photography, Flow velocity, Suspended sediments, Entrainment, England.

The local rate of relative sea level rise at Bridge Creek on the Dengie Peninsula in southeast Essex, England, is approximately 3 mm/year, but the salt marsh vegetation shows no sign of stress due to increased submergence indicating continued accretion of the marsh surface. Evidence from aerial photography shows that the marsh front has retreated by over 40 m since 1955. Monitoring of current velocity and suspended sediment concentrations over both spring and neap tides shows great variability in both the magnitude and direction of net flux. This is explained by changes in the velocity regime and the entrainment of sediment from within the creek system during certain tidal flow conditions. The accretion pattern on the marsh surface, measured over a two-year period, indicates that sediment eroded from the marsh surface, measured over a two-year period, indicates that sediment eroded from the marsh edge is locally more important in accretion than edge is locally more important in accretion than that delivered via the creek system. The resuspen-sion of sediment from within the creek system is a potential source of sediment for marsh accretion and nourishment which has rarely been identified in budgetary studies of marsh-sediment transport. nce of coastal marshes under a rap The mantenance of coastal marsnes under a rapid-ly rising sea level may require manipulation of the natural processes of sediment transport and deposi-tion. For this to be done effectively, sediment dynamics within the entire marsh system must be considered. (Shidler-PTT)

W88-08740

ACCRETION RATES IN SALT MARSHES IN THE EASTERN SCHELDT, SOUTH-WEST NETHERLANDS, Louisiana Water Resources Research Inst., Baton

Rouge.
O. Oenema, and R. D. DeLaune.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 26, No. 4, p 379-394, April 1988. 8 fig. 4 tab,

Descriptors: *Sedimentation, *Marsh plants, *Sedimentation rates, *Accretion, *Wetlands, *Salt marshes, Sediments, Cesium, Carbon, Organic carbon, Tidal range, Water level fluctuations, Spartina, Netherlands, Cores, Tracers, Model studies.

Vertical accretion and sediment accumulation rates were determined from the distribution of cesium137 in sediment cores, from historic documents, and from artificial white-colored tracer layers in salt marshes in the Eastern Scheldt. Salt marsh accretion is related to the steady rise of the mean high tide in the Eastern Scheldt during the last few decades. Mean accretion rates vary from 0.4-0.9 cm per year in the St. Annaland marsh to 1.0-1.5 cm/year in the Rattekaai marsh. Sediment accumulation in accreting marshes exceeds the loss of cm per year in the St. Annaiand marsh to 1.0-1.5 cm/year in the Rattekaai marsh. Sediment accumulation in accreting marshes exceeds the loss of sediment, by retreat of the marsh cliffs, by a factor of 10-20. Short-term spatial and temporal variations in accretion rates are large. Spatial variations are associated with levee and backmarsh sites and the density of marsh vegetation. Temporal variations are mainly related to fluctuations in hydrodynamic conditions. The net vertical accretion rate of organic carbon is about 0.4 kg per square m per year; approximately half this rate is associated with the current deposit, and the other half with net additions from the belowground root biomass. A simple model for the root biomass in sediments of the Rattekaai marsh is presented, which explains the distribution of living and fossilized root biomass in the upper 60 cm of these sediments quite well. (Shidler-PTT)

FOREST HARVEST AND SITE PREPARATION EFFECTS ON EROSION AND SEDIMENTA-TION IN THE OUACHITA MOUNTAINS, Oklahoma State Univ., Stillwater. Dept. of Forest-

For primary bibliographic entry see Field 4C. W88-08756

EFFECT OF SILTATION ON STREAM FISH COMMUNITIES, Missouri Univ., Columbia. School of Forestry. H. E. Berkman, and C. F. Rabeni. Environmental Biology of Fishes EBFID3, Vol. 18, No. 4, p 285-294, April 1987. 1 fig. 5 tab, 37 ref.

Descriptors: *Sedimentation, *Stream biota, *Fish behavior, *Streams, *Silting, *Fish, *Fish popula-tions, *Missouri, *Habitats, *Populations, Feeding, Reproduction, Population dynamics, Spawning.

The effect of siltation on stream fish in northeast Missouri was evaluated using community structur-al measurements and a functional approach that al measurements and a functional approach that emphasized feeding and reproductive guilds. As the percentage of fine substrate increased, the distinction among the riffle, run, and pool communities decreased, primarily because the number of individuals of typical riffle species decreased. Within the riffle communities, the abundance of fish of two feeding guilds - benthic insectivores and herbivores - was reduced as the percent of fine substrate increased. The abundance of fish in other feeding guilds was not affected. The only reproductive guild to be similarly affected was the simple and lithophilous, whose members require a clean gravel substrate for spawning. Species within each guild affected by siltation had significantly similar trends in abundance. The guild analysis indicated that species with similar ecological requirements had a common response to habitat degradation by siltation. (Author's abstract)

STUDY OF THE OCCURRENCE AND DISTRI-BUTION OF BDELLOVIBRIOS IN ESTUA-RINE SEDIMENT OVER AN ANNUAL CYCLE.

Maryland Univ., Baltimore. Dental School For primary bibliographic entry see Field 2L. W88-08800

SEDIMENTATION RATES IN THE CENTRAL LAKE CONSTANCE DETERMINED WITH 210PB AND 137CS,

Bern Univ. (Switzerland). Radiochemisches Lab. For primary bibliographic entry see Field 2H. W88-08828

SETTLING VELOCITY AND RESIDENCE TIME OF PARTICLES IN LAKE CONSTANCE, Konstanz Univ. (Germany, F.R.). Limnological

For primary bibliographic entry see Field 2H. W88-08829

PHYSICS OF SEDIMENT TRANSPORT, RESU-SPENSION, AND DEPOSITION,

National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

J. R. Bennett. Hydrobiologia HYDRB8, Vol. 149, p 5-12, June 1987. 10 fig, 10 ref.

Descriptors: *Sediment transport, *Sedimentation, *Lakes, *Suspension, *Deposition, *Lake sediments, *Limnology, *Model studies, Prediction, Great Lakes, Sediments, Physical properties.

The physics of sediment transport, resuspension and deposition is reviewed. First, the general problem is described and then emphasis is given to recent quantitative research in Lakes Ontario, Michigan and Erie. In this discussion, some original calculations are presented to show that Ekman layer sediment transport is important in determin-ing the deposition areas in deep lakes. The removal time for sediments is the time a given particle spends in contact or potential contact with either spends in contact or potential contact with either water or animals. The problems of estimating the removal time and of understanding the physical processes of settling, resuspension, and burial occur in many physical systems. The time and length scales for harbors, lakes, estuaries, rivers, and oceans may differ, but the physical questions: (1) Do we know the basic sediment mass balance the source of sediment and the amounts of suspended, active, and buried sediments; (2) Do we know the effects of currents on the distribution of sediments; (3) Do we understand the system well know the effects of currents of the system well enough to predict the behavior of a pollutant; and (4) Can we confidently apply the knowledge of the system to a similar system. (Alexander-PTT)

SEDIMENTS AS A SOURCE FOR CONTAMI-

Institute for Soil Fertility, Haren (Netherlands). For primary bibliographic entry see Field 5B. W88-08857

CHANGE IN THE QUALITIES OF WATER AND BOTTOM SEDIMENT WITH THE DE-VELOPMENT OF ANOXIC LAYER IN A STRATIFIED LAKE,

Kyoto Univ., Otsu (Japan). Otsu Hydrobiological

For primary bibliographic entry see Field 2H. W88-08886

SAMPLING TECHNIQUES FOR GRAVEL SIZED SEDIMENTS,

Iowa Univ., Iowa City. Dept. of Civil and Envi-ronmental Engineering. For primary bibliographic entry see Field 7B. W88-08914

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STUDY OF THE INSTANTANEOUS EROSION OF CAVITATION, VERSUS FLOW, PRESSURE AND TEMPERATURE (ETUDE DE L'ERO-SION INSTANTEE DE CAVITATION EN FONCTION DE DEBIT, DE LA PRESSION ET DE LA TEMPERATURE), Ecole Superieure d'Electricite, Gif-sur-Yvette

L. H. Chincholle.

Journal of Hydraulic Research JHYRAF, Vol. 26, No. 1, p 67-82, May 1988. 15 fig, 8 ref.

Descriptors: *Erosion, *Cavitation, *Flow, *Erosion rates, *Water pressure, *Water temperature, Hydraulics, Measuring instruments, Instantaneous erosive intensity.

The use of a new apparatus which measures the instantaneous erosive intensity of a flow gives the erosion variations versus temperature, flow and cavitation coefficient for a small cavitation. In each case, there exists a maximum of erosion. Similar results were obtained during trials on a hydraulic turbine (2000 kW). (Author's abstract)

2K. Chemical Processes

MOVEMENT OF AMMONIUM NITRATE INTO UNSATURATED SOIL DURING UNSTEADY ABSORPTION, Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.

Physiology.

For primary bibliographic entry see Field 2G. W88-07988

NITROGEN TRANSPORT DURING DRIP FER-TIGATION WITH UREA,

Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant

For primary bibliographic entry see Field 2G. W88-07989

EFFECT OF LOW ELECTROLYTE CONCENTRATION ON HYDRAULIC CONDUCTIVITY SODIUM/CALCIUM-MONTMORILLON-ITE-SAND SYSTEM,

Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.

For primary bibliographic entry see Field 2G. W88-07993

RELATIONS AMONG SULFATE, ALUMINUM, IRON, DISSOLVED ORGANIC CARBON, AND PH IN UPLAND FOREST SOILS OF NORTH-WESTERN MASSACHUSETTS, Williams Coll., Williamstown, MA. Center for En-

vironmental Studies.
For primary bibliographic entry see Field 5B.
W88-07999

ORGANIC MATTER SOLUBILITY AND SOIL REACTION IN AN AMMONIUM AND PHOSPHOROUS APPLICATION ZONE, Kansas State Univ., Manhattan. Dept. of Agrono-

For primary bibliographic entry see Field 2G. W88-08000

DETERMINATION OF INORGANIC ARSENIC (III) AND ARSENIC (III PLUS V) USING AUTOMATED HYDRIDE-GENERATION ATOMIC-ABSORPTION SPECTROMETRY, Agricultural Research Service, Riverside, CA. Salinity Lab.

For primary bibliographic entry see Field 5A. W88-08002

MICROBIAL FERROUS IRON OXIDATION IN ACIDIC SOLUTION,
Carnegie Inst. of Tech., Pittsburgh, PA. Dept. of

Civil Engineering.
For primary bibliographic entry see Field 5B.

W88-08009

AMMONIUM REGENERATION AND BIO-MASS OF MACROZOOPLANKTON AND CTENOPHORES IN GREAT SOUTH BAY, NEW YORK, Inha Univ., Inchon (Republic of Korea). Dept. of

Oceanography. For primary bibliographic entry see Field 2L. W88-08017

RAPID DETERMINATION OF MAGNESIUM AND CALCIUM HARDNESS IN WATER BY ION CHROMATOGRAPHY,

ION CHROMATUGRAPHY, Ames Lab, IA. D. L. Smith, and J. S. Fritz. Analytica Chimica Acta ACACAM, Vol. 204, No. 1/2, p 87-93, January 15, 1988. 1 fig. 3 tab, 12 ref. U.S. Dept. of Energy Contract No. W-7405-Eng-

Descriptors: *Chemical analysis, *Water analysis, *Hardness, *Magnesium, *Calcium, *Chromatography, Spectrophotometry, Chemical precipitation, Sample preparation, Chemical properties.

Mg(++) and Ca(++) in hard water are separated by ion chromatography and detected spectro-photometrically after a post-column reaction with arsenazo-1 at pH 10. No sample dilution or pre-treatment is needed, and the separation is complete in 3 min. Linear calibration plots are obtained in the 2-400 mg/liter range. Many actual water samples from a variety of geographical locations were analyzed, and the results were compared with those obtained by EDTA titration. The advantages of the chromatographic method over titration are of the chromatographic method over titration are as follows: both Mg and Ca hardness, not just the total, are given; no dilution or sample preparation are necessary; and metal ions normally found in water do not interfere. (Cassar-PTT) W88-08021

PHYSICOCHEMICAL LIMNOLOGY OF MER-OMICTIC SALINE LAKE SOPHIA, CANADIAN ARCTIC ARCHIPELAGO,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec). For primary bibliographic entry see Field 2H. W88-08026

INTERACTIONS BETWEEN POLYCYCLIC AR-INVERACTIONS BEI WEER POLITUTELLE AROMATIC HYDROCARBONS AND NATURAL
AQUATIC HUMIC SUBSTANCES, CONTACT
TIME RELATIONSHIP,
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W88-08072

IMPORTANCE OF HYDROGEN IONS AND ALUMINUM IN REGULATING THE STRUC-TURE AND FUNCTION OF STREAM ECOSYS-TEMS: AN EXPERIMENTAL TEST,

Ontario Ministry of the Environment, Dorchester.
Dorset Research Center.
For primary bibliographic entry see Field 5C.
W88-08093

SPATIAL DISTRIBUTION OF DENITRIFYING ACTIVITY IN A STREAM DRAINING AN AGRICULTURAL CATCHMENT,

Oxford Univ. (England). Dept. of Plant Sciences. For primary bibliographic entry see Field 5B. W88-08112

MACRO-FLORAL ASSEMBLAGES IN UPLAND WELSH STREAMS IN RELATION TO ACIDITY, AND THEIR IMPORTANCE TO INVERTEBRATES, University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology. For primary bibliographic entry see Field 2H. W88-08113

ALUMINUM-FULVIC ACID INTERACTIONS: MECHANISMS AND APPLICATIONS,

Johns Hopkins Univ., Baltimore, MD. For primary bibliographic entry see Field 5F. W88-08128

MECHANISMS OF COAGULATION WITH ALUMINUM SALTS, Cornell Univ., Ithaca, NY. For primary bibliographic entry see Field 5F. W88-08129

INJECTING AN OXYGEN FIX,

Corps of Engineers, Savannah, GA. Savannah Dis-

For primary bibliographic entry see Field 5G. W88-08142

MODELS FOR THE DISSOLUTION OF CARBONATE ROCKS AND THE C13/C12 EVOLUTION OF CARBONATE GROUND WATERS (MODELLE DER KALK-AUFLOESUNG UND C13/C12-ENTWICKLUNG VON KARBONATGRUNDWAESSEN), Gesellschaft füer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. füer Radiohydrometrie. For primary bibliographic entry see Field 5C. W88-08145

WATER TREATMENT RELATED CHARACTERIZATION OF THE PHOTOCHEMICAL DEGRADATION PRODUCTS OF AQUATIC DEGRAPATION PRODUCTS OF AQUATIC HUMIC SUBSTANCES (AUFBEREITUNGSOR-IENTIERTE ASPEKTE DES PHOTOCHEMIS-CHEN ABBAUS AQUATISCHER HUMIN-STOFFE),

Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneolo-

For primary bibliographic entry see Field 5F. W88-08152

INVESTIGATIONS ON SPECTRAL INTERFER-ENCES IN ICP-AES (UNTERSUCHUNGEN UEBER SPEKTRALE INTERFERENZEN IN DER ICP-AES), For primary bibliographic entry see Field 5A. W88-08155

REPORT ABOUT EXPERIENCES IN INTER-COMPARISON STUDIES IN THE ADMINIS-TRATION FOR WATER ECONOMY OF RHEINLAND-PFALZ,

Landesamt fuer Wasserwirtschaft Rheinland-Pfalz, Mainz (Germany, F.R.). For primary bibliographic entry see Field 5A. W88-08160

COMPARISON OF STATIONARY HPLC-PHASES FOR THE SEPARATION OF POLY-CYCLIC AROMATIC HYDROCARBONS (16 PAH'S OF NBS-STANDARD), Gesamthochschule Paderborn (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik.

For primary bibliographic entry see Field 5A. W88-08161

HEADSPACE TECHNIQUE TO DETERMINE THE PRESENCE OF VOLATILE HYDROCAR-BONS IN DRINKING WATER. THE PROBLEMS ARISING FROM THE PREPARATION OF A BLANK SAMPLE AS WELL AS THE CLEANING OF THE SAMPLE APPARATUSES, Gemeinnutzige G.m.b.H., Algau (Germany, F.R.). For primary bibliographic entry see Field 5A. W88-08162

DETERMINATION OF TRIAZINE-HERBI-CIDES AND THEIR METABOLITES IN WATER SAMPLES BY GAS CHROMATOGRA-

Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie. For primary bibliographic entry see Field 5A.

Chemical Processes—Group 2K

W88-08173

RELATIONSHIP BETWEEN HYDROGEN AND SULPHATE IONS IN PRECIPITATION: A NU-MERICAL ANALYSIS OF RAIN AND SNOW-FALL CHEMISTRY,

A.S.L. and Associates, Helena, MT. For primary bibliographic entry see Field 5B. W88-08201

EFFECT OF SURFACTANTS ON THE DETERMINATION OF NITRITE AND NITRATE IN WATER SAMPLES,

Thessaloniki Univ., Salonika (Greece). Environ-mental Pollution Control Lab. For primary bibliographic entry see Field 5A. W88-08240

DETERMINATION OF TRI-N-BUTYLTIN AND DI-N-BUTYLTIN COMPOUNDS IN FISH BY GAS CHROMATOGRAPHY WITH FLAME PHOTOMETRIC DETECTION,

National Inst. of Hygienic Sciences, Tokyo (Japan). Div. of Foods.
For primary bibliographic entry see Field 5A.
W88-08241

SNOWPACK ION ACCUMULATION AND LOSS IN A BASIN DRAINING TO LAKE SUPE-

Michigan Technological Univ., Houghton. Dept. of Biological Sciences. R. Stottlemyer.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 11, p 1812-1819, November 1987. 7 fig. 2 tab, 22 ref.

Descriptors: *Chemistry of precipitation, *Path of pollutants, *Snowpack, *Ion accumulation, *Stream chemistry, *Ion transport, *Acid rain, *Snowpack retention, Basins, Watersheds, Precipitation, Calcium ion, Hydrogen ion, Potassium ion, Lake Superior.

The objective of this study was to relate winter precipitation ionic inputs, snowpack retention and change in first-order stream chemistry with spring snowpack melt. During winter 1982-83, measuresnowpack melt. During winter 1982-83, measurements of precipitation inputs, snowpack concentration and loading and streamwater concentration and discharge of Ca(+2), K(+), H(+), NO3(-) and SO4 (2-) from a 176-ha watershed reveals that only H(+) might be lost from the snowpack before first thaw. Above-freezing soil temperature beneath the snowpack may be a factor in H(+) loss. An initial 1-day thaw resulted in loss of over one third (6 eq per ha) of the snowpack Ca(2+). Over one-half of the snowpack load of K(+), H(+), NO3(-) and SO4 (2-) was lost in a subsequent midwinter freeze-thaw period. Snowpack loading NO3(-) and SO2 (2-) was lost in a subsequent indiwinter freeze-thaw period. Snowpack loading of ionic species was reduced by 70-90% before peak spring melting and stream discharge. Ecosystem H(+) retention and biological uptake of NO3(-) further mitigate ionic 'pulses' in streamwater. Sulfate discharge exceeds bulk inputs which suggests insufficant development input and listle suggests significant dry deposition input and little forest soil retention of this anion. The snowpack was relatively small which limits wider application of these results to the region. (Author's abstract) W88-08265

CONTRIBUTION OF CALCITE TO THE PARTICLE-SIZE SPECTRUM OF LAKE MICHIGAN SESTON AND ITS INTERACTIONS WITH THE PLANKTON,

National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

For primary bibliographic entry see Field 2H. W88-08266

TIME-SAVING FILTRATION SYSTEM FOR NUTRIENT ANALYSIS.

Wisconsin State Lab. of Hygiene, Madison For primary bibliographic entry see Field 7B. W88-08268 SUBCELLULAR PHOSPHORUS KINETICS FOR LAKE ONTARIO PLANKTON, National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div. For primary bibliographic entry see Field 2H. W88-08273

ALTERATION OF CARBON CYCLING BY BEAVER: METHANE EVASION RATES FROM BOREAL FOREST STREAMS AND RIVERS, University Coll. of North Wales, Bangor. School of Animal Biology. For primary bibliographic entry see Field 2H. W88-08103

DEUTERIUM AND OXYGEN-18 STUDIES IN GROUNDWATER OF THE DELHI AREA,

Panjab Univ., Chandigarh (India). Centre of Advanced Study in Geology.
For primary bibliographic entry see Field 2F.
W88-08332

HYDROCHEMISTRY AND GROUNDWATER SYSTEM OF THE ZERKA MA'IN-ZARA THER-MAL FIELD, JORDAN, JORDAN Univ., Amman. Water Research and Study

Center. For primary bibliographic entry see Field 2F. W88-08333

CHLORIDE IN PRECIPITATION AND STREAMWATER FOR THE UPLAND CATCH-MENT OF RIVER SEVERN, MID-WALES: SOME CONSEQUENCES FOR HYDROCHE-MICAL MODELS, Institute of Hydrology, Wallingford (England). C. Neal, N. Christophersen, R. Neale, C. J. Smith, and P. G. Whitehead.
Hydrological Processes HYPRE3, Vol. 2, No. 2, p. 155-165. April 1988, 7 fig. 28 ref

155-165, April 1988. 7 fig, 28 ref.

Descriptors: *Water chemistry, *Water quality, *Rainfall, *Chemistry of precipitation, *Chlorides, Streams, Catchment areas, Simulation analysis, Stochastic models, Wales.

Variations in the concentration of Cl in rainfall and Variations in the concentration of Cl in rainfall and stream runoff are presented for two catchments in the Hafren forest of mid-Wales. Despite the large fluctuations in rainfall concentrations, Cl in the streamwater remains relatively constant. Using the two-reservoir Birkenes model, an attempt was made to simulate observed Cl in streamwater. The original model was unable to reproduce the observations and several modifications are suggested to revoke better simulations. The resulting model is provide better simulations. The resulting model is not the only one capable of reproducing the obser-vations; other hydrochemical models will probably values, once this although emphasis will in each case be placed on different aspects. It is suggested that the stochastic properties of water movement and chemical processes can account for the streamand chemical processes can account for the stream-water chemistry responses observed. On the catch-ment scale these processes will lead to an apparent-ly deterministic behavior that may well be de-scribed by simple relationships. (Author's abstract) W88-08369

NATIONAL SURFACE WATER SURVEY. WESTERN LAKE SURVEY (PHASE I -- SYN-OPTIC CHEMISTRY): ANALYTICAL METH-ODS MANUAL, Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV. For primary bibliographic entry see Field 5A. W88-08423

CHEMISTRY OF ACID RAIN: SOURCES AND ATMOSPHERIC PROCESSES. Allied-Signal, Inc., Des Plaines, IL. Engineered Materials Research Center. For primary bibliographic entry see Field 5B. W88-08442

DECADE OF ACID RAIN RESEARCH.

Maryland Univ., College Park. Dept. of Chemis-For primary bibliographic entry see Field 5B. W88-08443

SUBCONTINENTAL AIR POLLUTION PHE-

NOMENA, Nowada Univ. System, Reno. Desert Research Inst. For primary bibliographic entry see Field 5B. W88-08444

ACID DEPOSITION AND ATMOSPHERIC CHEMISTRY AT ALLEGHENY MOUNTAIN, Ford Motor Co., Dearborn, MI. Research Staff. For primary bibliographic entry see Field 5B. W88-08445

WESTERN ATLANTIC OCEAN EXPERIMENT, Virginia Univ., Charlottesville. Dept. of Environntal Science For primary bibliographic entry see Field 5B.

HYBRID RECEPTOR MODELS,

Environmental Protection Agency, Research Tri-angle Park, NC. Atmospheric Sciences Research Lab. For primary bibliographic entry see Field 5B. W88-08447

AQUEOUS-PHASE REACTIONS IN CLOUDS, Brookhaven National Lab., Upton, NY. Environ-mental Chemistry Div. For primary bibliographic entry see Field 5B. W88-08450

ACCOMMODATION COEFFICIENTS OF OZONE AND SO2: IMPLICATIONS ON SO2 OXIDATION IN CLOUD WATER, Brookhaven National Lab., Upton, NY. Environ-

mental Chemistry Div.
For primary bibliographic entry see Field 5B.
W88-08451

PHOTOCATALYTIC FORMATION OF HY-DROGEN PEROXIDE, California Inst. of Tech., Pasadena. W.M. Keck Engineering Lab. of Hydraulics and Water Re-For primary bibliographic entry see Field 5B. W88-08452

DIRECT KINETIC AND MECHANISTIC STUDY OF THE OH-DIMETHYL SULFIDE REACTION UNDER ATMOSPHERIC CONDI-

TIONS, Georgia Tech Research Inst., Atlanta. For primary bibliographic entry see Field 5B. W88-08453

SO2 OXIDATION BY HYDROGEN PEROXIDE IN SUSPENDED DROPLETS,

Frankfurt Univ. (Germany, F.R.). Inst. fuer Meteorologie und Geophysik. For primary bibliographic entry see Field 5B. W88-08454

MEASUREMENT OF CONCENTRATION AND OXIDATION RATE OF S(IV) IN RAINWATER IN YOKOHAMA, JAPAN,

Keio Univ., Yokohama (Japan). Dept. of Applied For primary bibliographic entry see Field 5B. W88-08455 Chemistry.

CHARACTERIZATION OF A FACILITY TO SIMULATE IN-CLOUD CHEMICAL TRANS-FORMATIONS.

Nevada Univ. System, Reno. Energy and Environ-mental Engineering Center. For primary bibliographic entry see Field 7B.

Group 2K—Chemical Processes

W88-08457

INTRODUCTION OF FORMATE AND ACE-TATE IONS INTO PRECIPITATION: ASSESS-MENT OF POSSIBLE PATHWAYS,

Battelle Pacific Northwest Labs., Richland, WA E. G. Chapman, and D. S. Sklarew.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 219-228, 2 fig, 5 tab, 23

Descriptors: *Acid rain, *Statistical analysis, *Formates, *Acetic acid, *Ions, *Correlation analysis, *Chemistry of precipitation, *Path of pollutants, Chemical reactions, Atmospheric water.

Statistical analysis of data from three sites in the eastern United States (in WI and VA) suggests that little or no correlation exists between low molecular weight organic and inorganic ion concentra-tions in precipitation, whereas organic ions such as formate and acetate are highly correlated and are probably introduced into precipitation by the same pathway. Based on agreement between observed and calculated potential clear air concentrations of formic and sectio scient the west plantified and and calculated potential creat air concentrations of formic and acetic acids, the most plausible path-way involves the scavenging of gas-phase-pro-duced precursors. Further assessment of atmos-pheric hydrocarbon reactions is needed to identify specific mechanisms and precursors in this path-way better. (See also W88-08442) (Author's abstract) W88-08461

CHEMISTRY OF WINTERTIME WET DEPOSI-

General Motors Research Labs., Warren, MI. Environmental Science Dept.

For primary bibliographic entry see Field 5B. W88-08463

POLLUTANT DEPOSITION IN RADIATION

California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B. W88-08464

DEPOSITION OF CHEMICAL COMPONENTS

Meteorological Research Inst., Yatabe (Japan). For primary bibliographic entry see Field 5B. W88-08465

ACID CLUSTERS.

Pennsylvania State Univ., University Park. Dept. of Chemistry. R. G. Keesee, and A. W. Castleman.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 317-323, 29 ref.

Descriptors: *Acid clusters, *Aerosols, *Inorganic acids, *Gases, *Chemical reactions, *Acid rain, Nitric acid, Hydrochloric acid, Ammonia, Sulfur dioxide, Air pollution, Spectrometers.

Gas phase molecular aggregates that contain acid molecules have been produced with free jet expansion techniques and detected by using electron impact ionization mass spectrometry. The clusters of aqueous nitric acid paralleled many properties of the condensed phase. Multiple nitric acid molecules were found in the clusters that were sufficiently dilive. The acid treadent nurs electer in fileciently dilute. The acid molecule was absent in the ionized clusters involving HCl and only water was evident. Experiments also demonstrated the reac tivity of ammonia with aqueous nitric acid and sulfur dioxide clusters and sulfur trioxide with water clusters. The natural occurrence of acid cluster negative ions offers a means to probe the gas phase acid loading of the atmosphere through laboratory and field studies of the ion chemistry. (See also W88-08442) (Author's abstract)

PHOTOCHEMISTRY OF ENVIRONMENTAL AQUATIC SYSTEMS.
Miami Univ., FL.
For primary bibliographic entry see Field 5B.

W88-08526

SPECIFIC PHOTOTRANSFORMATION OF XENOBIOTIC COMPOUNDS: CHLOROBEN-

XENOBIUTIC COMPOUNDS: CHLOROBEN-ZENES AND HALOPHENOLS, Clermont-Ferrand-2 Univ., Aubiere (France). Lab. de Photochmie Moleculaire et Macromoleculaire. For primary bibliographic entry see Field 5B. W88-08527

PHOTOLYSIS OF PHENOL AND CHLORO-PHENOLS IN ESTUARINE WATER, Georgia Univ., Athens. Dept. of Microbiology. For primary bibliographic entry see Field 5B. W88-08528

SUNLIGHT PHOTOLYSIS OF SELECTED IN-DOLES AND CARBAZOLE IN AQUEOUS COAL-OIL SYSTEMS, Argonne National Lab., IL. Environmental Research Div.

For primary bibliographic entry see Field 5B. W88-08529

QUANTUM YIELDS OF POLYCHLORODI-BENZO-P-DIOXINS IN WATER-ACETONI-TRILE MIXTURES AND THEIR ENVIRON-MENTAL PHOTOTRANSFORMATION RATES,

Manitoba Univ., Winnipeg. Pesticide Research Lab. For primary bibliographic entry see Field 5B. W88-08530

MECHANISM OF PHOTOLYTIC OZONA-

TION, SumX Corp., Austin, TX. For primary bibliographic entry see Field 5D. W88-08531

PRIMARY PHOTOCHEMICAL PROCESSING IN PHOTOLYSIS MEDIATED BY HUMIC SUBSTANCES,

California Univ., Santa Cruz. Dept. of Chemistry. For primary bibliographic entry see Field 5B. W88-08532

LASER FLASH PHOTOLYTIC STUDIES OF .: WELL-CHARACTERIZED SOIL HUMIC SUB-

Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Chemistry. For primary bibliographic entry see Field 5B. W88-08533

DG POLYCYCLIC AROMATIC HYDROCAR-BONS, ACTING AS PHOTOSENSITIZERS, PARTICIPATE IN THE TOXIC EFFECTS OF

ACID RAIN, Illinois Univ. at Chicago Circle. Dept. of Chemis For primary bibliographic entry see Field 5C. W88-08534

PHOTOCHEMISTRY IN AQUEOUS SURFACE LAYERS: 1-NAPHTHOL,
Illinois Univ. at Urbana-Champaign. Inst. for Envi-

For primary bibliographic entry see Field 5B. W88-08535

ALGAL-INDUCED DECAY AND FORMATION OF HYDROGEN PEROXIDE IN WATER: ITS POSSIBLE ROLE IN OXIDATION OF ANI-LINES BY ALGAE,

Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab. For primary bibliographic entry see Field 5B. W88-08536

PHOTOCATALYSIS BY INORGANIC COMPONENTS OF NATURAL WATER SYSTEMS,

Concordia Univ., Loyola Campus, (Quebec). Dept. of Chemistry.

(Queocy). Dept. of Chemistry C. H. Langford, and J. H. Carey. IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. Ameri-can Chemical Society, Washington, D.C. 1987. p 225-239, 4 fig. 27 ref.

Descriptors: *Wastewater treatment, *Photoactivation, *Photochemistry, Fate of pollutants, Chemical properties, Colloids, Chemical reactions, Oxides, Sulfides, Ion exchange, Clays, Inorganic compounds, Biodegradation, Organic compounds.

A brief inventory of aquatic components potentially active as photocatalysts includes colloidal and ly active as photocatalysts includes colloidal and sedimentary oxides and sulfides, metal complexes of organic ligands, and certain metal ions in clays. The reactions are to be understood in terms of the redox reactions following ligand to metal charge transfer and its extension to solid lattices, reactions of photogenerated electron hole pairs according to the microcorrosion cell model. Photocatalysis along both reductive and oxidative pathways is restituted using reactific extension may of which along both reductive and oxidative pathways is reviewed using specific examples, many of which were explored for their possible use in photochemical wastewater treatment. Evidence for photooxidative activity of ferric oxides is presented. It is possible that pathways initiated by inorganic photocatalysts may not terminate with the immediate reactions but may render organic products that are accessible to biodegradation. (See also W88-08526) (Friedmann-PTT) W88-08537

PHOTOCHEMICAL MODELING APPLIED TO

NATURAL WATERS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Marine and Atmospheric

J. M. C. Plane, R. G. Zika, R. G. Zepp, and L. A.

IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. Ameri-can Chemical Society, Washington, D.C. 1987. p 250-267, 11 fig. 17 ref.

Descriptors: *Photochemistry, *Photoactivation, *Natural waters, *Model studies, Chemical properties, Absorption, Chemical reactions, Organic compounds, Quantum yield.

The application of modeling photochemical processes in natural water systems was examined. For many photochemical reactions occurring in natural many photochemical reactions occurring in natural waters a simple photochemical model describing reaction rate as a function of intensity, radiation attenuation, reactant absorptivity and quantum yield is insufficient. Other factors governing the species distribution must be considered. These factors are divided into processes that cause production, decay, and mixing and transport. Three different photochemically active compounds were used as examples to illustrate how these various factors affect their distribution. Hydrogen perovides used as examples to illustrate how these various factors affect their distribution. Hydrogen peroxide was used as an example of a compound which is produced in situ, while trifluralin and pentachlorophenol are compounds that have very different absorption spectra and are introduced from external sources. The photochemically mediated distribution of these example compounds is evaluated by taking into consideration the effects of light attenuation equilibrium partitioning of the compound taking into consideration the effects of light attenu-ation, equilibrium partitioning of the compound into nonaqueous phase (e.g. sediments), and physi-cal mixing in the water column. (See also W88-08526) (Author's abstract) W88-08539

MEASUREMENT OF QUANTUM YIELDS IN POLYCHROMATIC LIGHT: DINITROANILINE HERBICIDES,

Minnesota Univ., Minneapolis. School of Public For primary bibliographic entry see Field 5B. W88-08540

ACID RAIN: CHEMISTRY AND TRANSPORT.

Chemical Processes—Group 2K

Warren Spring Lab., Stevenage (England). For primary bibliographic entry see Field 5B. W88-08561

HEAVY METALS IN LAKE KINNERET (ISRAEL): II. HYDROGEN SULFIDE DEPEND-ENT PRECIPITATION OF COPPER, CADMI-UM, LEAD AND ZINC,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.

For primary bibliographic entry see Field 2H. W88-08582

MIXING OF RIVER WATER IN RIVER YODO, (IN JAPANESE), Osaka City Univ. (Japan). Faculty of Engineering. For primary bibliographic entry see Field 2E. W88-08630

DISTRIBUTION OF PARTICULATE ORGANIC MATTER IN THE LOWER PART OF THE TAMA RIVER, (IN JAPANESE), Tokyo Metropolitan Univ. (Japan). Dept. of

For primary bibliographic entry see Field 2L. W88-08641

DENITRIFYING ACTIVITY AND POPULA-TION GROWTH OF DENITRIFYING BACTE-RIA IN LAKE FUKAMI-IKE, Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 2H. W88-08644

ACTIVE DENITRIFICATION IN THE HYPO-LIMNETIC WATER COLUMN IN LAKE LIMNETIC KIZAKI.

Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 2H. W88-08645

BEHAVIOR OF DISSOLVED MANGANESE IN

LAKE OHNUMA, Hokkaido Univ., Hakodate (Japan). Dept. of

K. Matsunaga, K. Tani, I. Kudo, K. Abe, and K. Japanese Journal of Limnology RIZAA, Vol. 48, No. 4, p 243-247, December 1987. 5 fig, 11 ref.

Descriptors: *Manganese, *Ohnuma Lake Japan, *Lakes, *Seasonal variation, *Suspended sediments, Lake sediments, Riparian waters, Adsorption, Plankton, Oxidation.

The dissolved manganese concentrations in lake and river waters was monitored monthly for a one-year period and showed significant seasonal changes. In April, the lake water manganese concentration increased about two-fold compared to that in river water and decreased almost to zero during the summer months. Laboratory studies revealed that such a seasonal change was due to the rediscipling of manganese from supergladed. revealed that such a seasonal change was due to the redissolution of manganese from suspended matter (primarily from lake sediments) generated through wind mixing of the lake water in Aprii and manganese re-adsorption on suspended matter (primarily from dead plankton) during the summer months. Manganese adsorbed on suspended matter is slightly oxidized to Mn (III) or Mn (IV). (Au-thor's abstract) W88.08647

STUDIES ON DENITRIFICATION IN THE WATER COLUMN OF LAKE KIZAKI AND LAKE FUKAMI-IKE, Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 2H. W88-08649

WATER QUALITY FORMATION OF INLAND WATER IN THE DRAINAGE BASIN OF LAKE CHUZENJI, NIKKO, (IN JAPANESE), Tochigi Prefectural Research Inst. for Environmental Pollution, Utsunomiya (Japan).

For primary bibliographic entry see Field 2H. W88-08652

EFFECTS OF ORGANIC MATERIALS IN WATER ON THE DESORPTION OF COPPER FROM BOTTOM MUDS AS INFERRED FROM COPPERII) COMPLEXING CAPACITY, (IN JAPANESE).

Gunma Inst. of Public Health (Japan). For primary bibliographic entry see Field 5B. W88-08653

HYDROLOGIC CONTROL OF ALUMINUM CHEMISTRY IN AN ACIDIC HEADWATER Maine Univ. at Orono. Dept. of Plant and Soil

For primary bibliographic entry see Field 5B. W88-08659

EXTENT OF SNOWPACK INFLUENCE ON WATER CHEMISTRY IN A NORTH CASCADES LAKE,
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
For primary bibliographic entry see Field 2H.
W88-08665

DISTRIBUTION OF NITROGEN SPECIES AND ADSORPTION OF AMMONIUM IN SEDIMENTS FROM THE TIDAL POTOMAC RIVER AND ESTUARY, Geological Survey, Reston, VA. For primary bibliographic entry see Field 2L. W88-08709

BEHAVIOUR OF URANIUM ISOTOPES WITH SALINITY CHANGE IN THREE U.K. ESTU-ARIES.

ARIES, Glasgow Univ. (Scotland). Dept. of Chemistry. J. Toole, M. S. Baxter, and J. Thomson. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 3, p 283-297, September 1987. 7 fig, 3

Descriptors: *Isotope studies, *Trace elements, *Uranium, *Salinity, *Estuaries, *Rivers, *Tidal Rivers, *Saline-freshwater interfaces, United Kingdom, Mixing, Particulate matter, Phosphates, Regression analysis.

The behavior of natural uranium isotopes during estuarine mixing has been studied in three British estuaries. Uranium exhibits conservative behavior in the Clyde and Tamar Estuaries but there is evidence of removal in the Forth Estuary at salinities of less than 10 parts per thousand, where high particulate loads of up to 180 mg per liter occur. Phosphate removal is also observed in the Forth in this salinity range. The uranium removal rate in the upper part of this estuary is estimated at 44 kg per year. The uranium concentrations and corresponding U-234/L1-238 activity ratios measured for the year. The uranium concentrations and corresponding U-234/U-238 activity ratios measured for the freshwater end-members of the three rivers are: 0.14 micrograms per liter and 1.65 for the Clyde, 0.04 g per liter and 1.44 for the Tamar, and 0.09 micrograms per liter and 1.50 for the Forth. Regression analysis gives an overall uranium to salinity ratio of (9.53 plus or minus 0.84) times 10 to the range 5.0-33.2 parts per thousand for all three estuaries, which is in excellent agreement with values obtained by other workers. (Author's abstract) W88-08720

BIOGEOCHEMICAL STUDIES ON THE TRANSPORT OF ORGANIC MATTER ALONG THE OTSUCHI RIVER WATERSHED, JAPAN, Mitsubishi-Kasei Inst. of Life Sciences, Tokyo (Japan). Lab. of Biogeochemistry and Sociogeo-

E. Wada, M. Minagawa, H. Mizutani, T. Tsuji, and R. Imaizur

R. Imaizumi. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 3, p 321-336, September 1987. 6 fig, 4

Descriptors: *Water pollution sources, *Rivers, *Bays, *Sediments, *Bottom sediments, *Organic matter, *Carbon, *Organic carbon, *Nitrogen, endergo compounds, Spatial distribution, Biological properties, Chemical properties, Japan, Isotope studies, Stable isotopes, Depletion, Denitrification, Decomposition, Domestic wastes, Algae, Sea grasses, River systems, Ecosystems, Aquatic environment, Marine environment, Intertidal areas, Particulate matter, Particle size, Suspended solids, Marine sediments, Silt, Clay, Watersheds, Small Marine sediments, Silt, Clay, Watersheds, Small

The distributions and stable isotope ratios of biogenic nitrogen and carbon were investigated along a small watershed to establish a biogeochemical a small watersnet to establish a biogeochemical framework for assessing the fate of organic matter. Forest ecosystems supply soluble and particulate materials to river systems which are depleted in N-15 and C-13. The number of suspended particles and the concentrations of delta-15 nitrogen and delta-13 carbon in the river sediments increased along the watershed, indicating a change from along the watersned, indicating a change from river to marine ecosystems. Dramatic variations of delta-15 nitrogen and delta-13 carbon were ob-served in the intertidal sediments, where the progress of denitrification, discharge of domestic sewage, and the accumulation and the decomposition of macroalgae and seagrasses took place. The contribution of land-derived organic matter to es-tuarine sediments has been estimated from delta-13 carbon and from delta-15 nitrogen data. The contribution of the land-derived organo-silty-clay min eral was 70-100% in the inner-bay sediments and 34-42% at the open bay. The relationship between the sizes of particles and isotope ratios clearly demonstrated that organo-silty-clay minerals with diameter smaller than 64 microns were the major of land-derived refractory organics. (Shidler-PTT) W88-08723

EFFECT OF MANGANESE-COPPER INTER-ACTIONS ON GROWTH OF A DIATOM IN WATER FROM A MANGANESE-RICH BRIT-ISH COLUMBIA FJORD,

State Univ. of New York at Stony Brook. Marine Sciences Research Center

J. Kazumi, N. Zorkin, and A. G. Lewis. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 3, p 337-346, September 1987. 3 fig, 3 tab. 23 ref.

Descriptors: "Metals, "Heavy metals, "Copper, "Manganese, "Plankton, "Phytoplankton, "Chrysophyta, "Diatoms, "Plant growth, Aquatic life, Fjords, Canada, Chemical interference, Coastal waters, Absorption.

A competitive interaction between manganese and A competitive interaction between manganese and copper has previously been reported for the growth of marine phytoplankton. This was confirmed in an artificial medium with the marine diatom Thalassiosira pseudonana. The reduction in cell-division rate produced by excess copper was alleviated by increasing the concentration of man-ganese. This relationship was also found to exist in natural water from a silled British Columbia fjord; the reduction in cell division rate with added copper was less in manganese-rich deep water than in manganese-poor shallow water. In coastal waters, elevated concentrations of manganese occur under certain hydrographic conditions and have the potential to reduce the detrimental effects of excess biologically-available copper. At lower levels of copper, high concentrations of manganese may reduce uptake and produce a copper deficien-cy. (Author's abstract) W88-08724

PU-239,240 IN ESTUARINE AND SHELF WATERS OF THE NORTH-EASTERN UNITED STATES.

Woods Hole Oceanographic Institution, MA. For primary bibliographic entry see Field 2L.

Group 2K—Chemical Processes

CHEMISTRY OF MODERN SEDIMENTS IN A HYPERSALINE LAGOON, NORTH JEDDAH, RED SEA,

JEDDAH, RED SEA, Alexandria Univ. (Egypt). Dept. of Oceanography. M. K. El-Sayed. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 23, No. 4, p 467-480, October 1987. 11 fig, 1

Descriptors: *Water chemistry, *Sediments, *Marine sediments, *Chemical properties, *Salinity, *Lagoons, Sabkhas, Evaporation, Sedimentology, Sand, Lithification, Diagenesis, Mineralization, Carbonates, Organic carbon, Calcium, Magnesium, Strontium, Sodium, Potassium, Saudi Arabia, Jeddah, Red Sea.

Previous studies of modern peritidal sedimentary environments of the Red Sea, such as hypersaline lagoons and sea-marginal flats, have concentrated on its northern part, particularly the Gulf of Aqaba. However, little is known about lagoon sediments in other localities along the Red Sea coastal stretches. A study was conducted of the chemical characteristics of the sediments of a hypersaline (Ras Hatiba) lagoon, north of Jeddah, Saudi Arabia. Ras Hatiba lagoon is a hypersaline, elongated water body connected to the Red Sea by a narrow and shallow onening. The total area of a narrow and shallow opening. The total area of the lagoon is about 30 square km. Coarse bioclastic sands are dominant in the lagoon and mostly sursands are dominant in the jagoon and mostly sur-round lithified calcareous grounds. However, fine silt and clay sediments are present in separate patches. The sediments are rich in carbonates (av-erage 78.5%) and organic carbon (average 7.3%), although they are negatively correlated. Calcium (average 25.1%) and magnesium (average 10.8%) show a similar distribution pattern. Strontium (avshow a similar distribution pattern. Strontum (average 5.2%) is positively correlated with calcium. Sodium and potassium are relatively highly concentrated in the sediments (average 118 ppm and 173 ppm, respectively). Magnesium and strontum are of prime importance in the process of mineralization and diagenesis. The sabkha formation surization and diagenesis. The sabkha formation sur-rounding the lagoon is of low carbonate and or-ganic carbon content, compared with the lagoon sediments, while it is characterized by high magne-sium, sodium and potassium concentrations. Ras Hatiba lagoon sediments and sabkha resemble those of the northern Red Sea in the Gulfs of Aqaba and Suez and the Arabian Gulf in their major sedimentological and chemical characteris-tics. (Shidler-PTT) W88-08731

CHANGES IN CARBON AND HYDROGEN STABLE ISOTOPE RATIOS OF MACROAL-GAE AND SEAGRASS DURING DECOMPOSI-

Tasmania Univ., Hobart (Australia), Dept. of Zool-

ogy. G. E. Fenton, and D. A. Ritz. Stuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 4, p 429-436, April 1988. 2 fig. 2 tab, 21 ref. Marine Science and Technology Grant 84/

Descriptors: *Isotope studies, *Carbon, *Hydrogen, *Macrophytes, *Algae, *Sea grasses, *Decomposition, Leaching, Tasmania.

Stable isotope ratios of carbon and hydrogen were determined for six algae and one seagrass species during a 60-day decomposition experiment. The specimens were selected to give a representative sample of the macroalgae in southern Tasmania, and included members of the Chlorophyta, Phaophyta, and Rhodophyta, and a seagrass. Changes in the carbon ratios were in the order of 1 part per the caroon ratios were in the order of 1 part per thousand. However, significant isotopic changes were observed for hydrogen in all species and in most cases these changes were substantial. These changes probably reflect differential leaching of isotopically distinct compounds. (Author's ab-stract) stract) W88-08746

KINETICS OF ALKALINE PHOSPHATASE ACTIVITY AND PHOSPHORUS AVAILABILITY FOR PHYTOPLANKTON AND BACTERIO-PLANKTON IN LAKE PLUSSSEE (NORTH GERMAN EUTROPHIC LAKE),

Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
For primary bibliographic entry see Field 2H.

POTENTIAL RATES OF NITRIFICATION AND DENITRIFICATION IN AN OLIGOTROPHIC FRESHWATER SEDIMENT SYSTEM, Oregon Univ., Eugene. Dept. of Biology. For primary bibliographic entry see Field 2H. W88-08794

ANAEROBIC MICROBIAL METHYLATION OF INORGANIC TIN IN ESTUARINE SEDI-

MENT SLURRIES,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies. For primary bibliographic entry see Field 5B. W88-08798

LEACHING OF SILICA AND URANIUM AND OTHER QUANTITATIVE ASPECTS OF THE LITHOBIONTIC COLONIZATION IN A RADIOACTIVE THERMAL SPRING,

Katholieke Univ. Nijmegen (Netherlands). Lab. of Exobiology.

W. Heinen, and A. M. Lauwers. Microbial Ecology MCBEBU, Vol. 15, No. 2, p 135-149, 1988. 6 fig, 7 tab, 40 ref.

Descriptors; *Silica, *Uranium, *Leaching, *Thermal springs, *Radioactive springs, *Springs, *Microbiological studies, *Bacteria, *Thermophilic bacteria, Heavy metals, Ecosystems, Chemical re-

The formation of microbial mats by thermophilic Ine formation of microbial mass by thermophilic organisms on submerged rocks in radioactive thermal springs was followed quantitatively in situ as well as under experimental conditions, by determining the change in dry weight and organic matter as a function of time. Furthermore, the decay of the rock occurring in the springs could be shown to be directly related to the microbial colo-nization. Early in that process the formation of silicious gels, facilitating the settling of the orga-nisms, could be observed. Simultaneously, this was accomplished by the leaching of silica from the underlying rock. This resulted in the destruction of underlying rock. This resulted in the destruction of the rock, which had been altered to a fine-grained dust underneath the colonizing mats; the microorganisms were found to move further downward within this layer. From the heavy metals present in the rock - iron (Fe), copper (Cu), manganese (Mh), uranium (U) the leaching of uranium could be demonstrated, leading to the acquisition of this metal in the microbial mats in concentrations up to 15.34 microg/mg dry weight. Direct evidence for the leaching of Si(silicon) and U could be obtained by measurement of these elements after their reby measurement of these elements after their re-lease from ground rock chips in cultures with microorganisms from the hot springs at 50 degrees. X-ray analysis of the biomats strongly suggested that Cu, Mn, and Fe are also accumulated. (Author's abstract) W88-08803

FURTHER STUDIES OF SHORT-TERM VARIATION IN THE PIGMENT COMPOSITION OF ATION IN THE PIGMENT COMPONING A SPRING PHYTOPLANKTON BLOOM,

(England). For primary bibliographic entry see Field 2H. W88-08850

SEDIMENTS AS A SOURCE FOR CONTAMI-

NANTS, Institute for Soil Fertility, Haren (Netherlands). For primary bibliographic entry see Field 5B. W88-08857

EFFECT OF DISSOLVED OXYGEN CONCEN-TRATION ON THE BIOLOGICAL OXIDA-TION OF SULFIDE AND ELEMENTAL SULFUR BY THE A-TYPE SULFUR-TURF GROWING IN HOT SPRING EFFLUENTS, Iwate Medical Univ., Morioka (Japan). Dept. of

Journal of General and Applied Microbiology JGAMA9, Vol. 33, No. 5, p 391-400, October 1987. 5 fig, 1 tab, 27 ref.

Descriptors: *Hot springs, *Sulfur bacteria, *Biological oxidation, *Microbiological studies, Sulfur, Sulfur compounds, Dissolved oxygen, Hydrogen

The effects of dissolved oxygen concentrations on the rate of biological oxidation of sulfide and elemental sulfur by the A-type sulfur-turf was exam-ined. The rate of sulfide oxidation markedly inined. The rate of sulfide oxidation markedly increased concomitant with the increase in dissolved oxygen. Accompanying the sulfide oxidation, elemental sulfur was formed only a few minutes after the addition of hydrogen sulfide to the culture medium at a dissolved oxygen concentration of about 6 ppm. The catalase test of the A-type sulfur-turf was negative. As hydrogen peroxide is a very reactive intermediate inevitably accompanying the biological reduction of oxygen to water, it is probable that hydrogen sulfide was oxidized by hydrogen peroxide. These results could be explained if the production of hydrogen peroxide was more active under oxic than the microoxic conditions. On the other hand, the rate of the was more active under oxic than the microoxic conditions. On the other hand, the rate of the elemental sulfur oxidation was suppressed both at low (0.2 ppm) and at high (3 to 6 ppm) dissolved oxygen concentrations. The optimum was about 1.5 ppm. Therefore, the elemental sulfur oxidation by the A-type sulfur-turf was a microaerophilic reaction. Due to the continuous supply of anoxic water from a hot spring source, dissolved oxygen concentrations of the effluents where the A-type sulfur-turf occurred were kept under 1 ppm. At these low concentrations of dissolved oxygen, the oxidation of elemental sulfur was likely maximized, while the production of toxic hydrogen peroxide oxidation of remental sumir was likely maximized was likely minimized. These assumptions are sufficient to account for the presence of the A-type sulfur-turf in a microoxic habitat. (Author's abstract) W88-08896

TOTAL PARTICULATE AND ORGANIC FLUXES IN ANOXIC FRAMVAREN WATERS, Norsk Inst. for Vannforskning, Oslo. For primary bibliographic entry see Field 2L.

PARTITIONING AND ENRICHMENT OF TRACE METALS IN A SEDIMENT CORE FROM FRAMVAREN, SOUTH NORWAY, Norsk Inst. for Vannforskning, Oslo. For primary bibliographic entry see Field 2L.

SULPHUR CHEMISTRY OF A SUPER-ANOXIC FJORD, FRAMVAREN, SOUTH NORWAY,

Goeteborg Univ. (Sweden). Dept. of Analytical and Marine Chemistry. For primary bibliographic entry see Field 2L. W88-08931

SEASONAL CYCLING OF SULPHUR AND IRON IN POREWATERS OF A DELAWARE SALT MARSH,

Delaware Univ., Lewes. Coll. of Marine Studies. For primary bibliographic entry see Field 2L. W88-08932

TEMPORAL VARIATIONS OF SEDIMENTARY SULFUR IN A DELAWARE SALT MARSH, Old Dominion Univ., Norfolk, VA. Dept. of For primary bibliographic entry see Field 2L. W88-08933

SOLUTION CHEMISTRY OF IRON(II) IN FRAMVAREN FJORD, Florida State Univ., Tallahassee. Dept. of Ocean-

For primary bibliographic entry see Field 2L. W88-08934

FORMATION OF FRAMBOIDAL IRON SUL-FIDE IN THE WATER OF A PERMANENTLY ANOXIC FJORD - FRAMVAREN, SOUTH

Norsk Inst. for Vannforskning, Oslo. For primary bibliographic entry see Field 2L. W88-08935

CYCLING OF MANGANESE IN THE PERMA NENTLY ANOXIC DRAMMENSFJORD, Oslo Univ. (Norway). Biologisk Inst. For primary bibliographic entry see Field 2L. W88-08936

MODELLING THE MANGANESE CYCLING IN TWO STRATIFIED FJORDS. Oslo Univ. (Norway). Dept. of Geology. For primary bibliographic entry see Field 2L. W88-08937

DISTRIBUTIONS OF URANIUM, RADIUM AND THORIUM ISOTOPES IN TWO ANOXIC FJORDS: FRAMVAREN FJORD (NORWAY) AND SAANICH INLET (BRITISH COLUMBIA), South Carolina Univ., Columbia. Dept. of Geological Science. For primary bibliographic entry see Field 2L.

TRACE METALS IN THE WATER COLUMNS OF THE BLACK SEA AND FRAMVAREN

Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemis-

For primary bibliographic entry see Field 2L. W88-08939

SOME PECULIARITIES OF THE TRACE-METAL DISTRIBUTION IN BALTIC WATERS

AND SEDIMENTS,
Akademie der Wissenschaften der DDR, RostockWarnemuende. Inst. fuer Meereskunde.
For primary ibbliographic entry see Field 2L.
W88-08940

MERCURY IN THE NORWEGIAN FJORD FRAMVAREN,

Sweatsh Environmental Research Inst., Goete-For primary bibliographic entry see Field 5B. W88-08941

NUCLEATION OF SULFURIC ACID-WATER AND METHANESULFONIC ACID-WATER SO-LUTION PARTICLES: IMPLICATIONS FOR

ATMOSPHERIC CHEMISTRY OF ORGANO-SULFUR SPECIES, California Inst. of Tech., Pasadena. Dept. of Chemical Engineering. For primary bibliographic entry see Field 5B. W88-0894

NUMERICAL STUDIES OF ACIDIFICATION PROCESSES WITHIN AND BELOW CLOUDS WITH A FLOW-THROUGH CHEMICAL RE-ACTOR MODEL, Argonne National Lab., IL. Environmental Re-

earch Div.

For primary bibliographic entry see Field 5B. W88-08947

TIME-TRENDS OF SULFATE AND NITRATE IN PRECIPITATION IN NORWAY (1972-1982), Bergen Univ. (Norway). Geofysisk Inst. For primary bibliographic entry see Field 5B. W88-08948

ACID RAIN IN SOUTHWESTERN CHINA.

Academia Sinica, Beijing (China). For primary bibliographic entry see Field 5B. W88-08949

SOLUBILITY OF SOME NATURAL MINERALS IN ATMOSPHERIC PRECIPITATION, Arizona Univ., Tucson. Inst. of Atmospheric Phys-

Atmospheric Chemistry ATENBP, Vol. 22, No. 2, p 369-374, February 1988. 3 tab, 20 ref.

Descriptors: *Solubility, *Minerals, *Precipitation, *Trace elements, *Chemistry of precipitation, Bulk precipitation, Poorly soluble precipitation com-pounds, Precipitation solubility, Aluminum, Calci-um, Copper, Iron, Manganese, Magnesium, Nickel, Lead, Zinc.

Theoretical and experimental data on the aqueous solubility of a number of so-called 'poorly soluble' natural minerals are presented. The minerals were chosen as to represent 10 trace elements measured frequently in atmospheric precipitation. The experimental solubility obtained from standard literature was generally several orders of magnitude larger than that based on thermodynamic data. The highly enhanced solubility in the laboratory experiments, is probably due to hydrolysis. On the other hand, the concentrations of the trace elements in acid-treated bulk precipitation are, orders-of-magnitude smaller than the experimental values corresponding to their respective minerals considered. Therefore, such minerals in wet natural precipitation ought to be treated as soluble since their aqueous concentrations would only represent subsaturated solutions. (Author's abstract) W88-08951

POSSIBLE ROLE OF THE BIOSPHERE IN THE CONTROL OF ATMOSPHERIC CLOUDS AND PRECIPITATION, Institute for Atmospheric Physics, Budapest (Hun-

gary). For primary bibliographic entry see Field 2B. W88-08952

SIMILARITY BETWEEN SIZE SPECTRA OF FOG DROPLETS AND SIZE SPECTRA OF DROPLETS INDUCED IN AN ISOTHERMAL DROPLETS INDUCED IN AN ISOTHERMAL ICLOUD CHAMBER BY THE ATMOSPHERIC AEROSOL BEFORE FOG FORMATION: POSSIBILITY OF PREDICTING MICROPHYSICAL FEATURES OF FOG (SIMILITUDES DES SPECTRES DIMENSIONNELS, D'UNE PART, DES GOUTTELETTES DE BROUILLARDS NA-TURELS, D'AUTRE PART, DES GOUTTE-LETTES INDUITES EN CHAMBRE A BROUIL-LARD PAR L'AIR ATMOSPHERIQUE AVANT LE BROUILLARD: POSSIBILITE DE PRE-VOIR LES CHARACTERISTIQUES DU VOIR LES BROUILLARD),

Observatoire de Physique du Globe de Clermont-Ferrand (France).

Descriptors: *Fog, *Clouds, *Aerosols, *Humidi-ty, *Chemistry of precipitation, *Precipitation, *Condensation, Isotherms, Prediction, Isothermal cloud chamber, Microphysical features, Condensation nuclei, Size spectra.

Two natural fog events in different locations per-mitted the establishment of the similarity between the size spectra of fog droplets and the size spectra the size spectra of fog droplets and the size spectra of droplets induced in a continuous flow isothermal cloud chamber by the atmospheric aerosol before fog formation. This result tends to demonstrate the possibility of predicting the microphysical features of a fog from data analysis on condensation nuclei performed before the fog formation. The results obtained also point out that a fog of one or more hours duration is capable, after dissipation, of enhancing the antitude of the residual pation, of enhancing the aptitude of the residual aerosol to condense the water vapor very close to 100% of relative humidity. (Author's abstract)

2L. Estuaries

HYPOXIA AND SALINITY IN VIRGINIA ES-

William and Mary Coll., Gloucester Point, VA. William and Marly Coll, Collection of Marine Science.

A. Y. Kuo, and B. J. Neilson.

Estuaries ESTUDO, Vol. 10, No. 4, p 277-283, December 1987. 7 fig. 1 tab, 19 ref.

Descriptors: "Estuaries, "Estuarine environment, "Water quality, "Salinity, "Oxygen deficit, "Hy-poxia, Bottom water, James River, York River, Rappahannock River, Virginia, Wastewater, Merine fisheries

Hypoxia, periods of reduced dissolved oxygen concentration, has been observed not only in the concentration, has been observed not only in the Chesapeake Bay but also in the deeper waters of the Virginia estuaries that are tributaries to the Chesapeake Bay. When water temperature exceed-20 C, minimum oxygen-concentrations were observed to be <50% of saturation concentrations in 75%, 50%, and 2% of the surveys in the estuaries of the Rappahannock, York and James rivers, respectively. The observation that hypoxia rarely occurred in the James River is surprising, given the fact that it receives the greatest amount of wastewater. Analysis of the oxygen budgets in these estuaries indicates that the variations in the wastewater. Analysis of the oxygen oudgets in these estuaries indicates that the variations in the frequency, duration, and severity of hypoxia are related to the net movement of bottom waters. This relationship has significant implications for the management of water quality and marine fish-eries. (Author's abstract) W88-08012

RECURRENT AND PERSISTENT BROWN TIDE BLOOMS PERTURB COASTAL MARINE

State Univ. of New York at Stony Brook. Marine Sciences Research Center.

E. M. Cosper, W. C. Dennison, E. J. Carpenter, V. M. Bricelj, and J. G. Mitchell. Estuaries ESTUDO, Vol. 10, No. 4, p 284-290, December 1987. 5 fig, 1 tab, 32 ref.

Descriptors: *Coastal waters, *Estuarine environ-ment, *Eutrophication, *Marine algae, *Algal growth, *Chrysophyta, Bays, Long Island, Rhode Island, New Jersey, Sea grasses, Mollusks, Light penetration, Commerical fishing.

Throughout the summers of 1985 and 1986 a small (2-3 micron diameter), previously undescribed chrysophyte bloomed monospecifically (>1 billion cells /l) in Long Island embayments. The bloom colored the water dark brown, decimated eelgrass colored the water cark brown, decimated eeigrass beds through decreased light penetration and caused starvation (tissue weight loss) and recruitment failure of commercially important bay scallop populations. These perturbations portend longerm changes in subtidal communities. Similar and concurrent blooms in bays of Rhode Island and New Jersey suggest a meteorological component of the environmental conditions promoting bloom formation. Culture experiments with isolates of the microalga suggest the presence of stimulatory growth factors in the bloom seawater. (Author's abstract) abstract) W88-08013

SEASONAL AND SPATIAL DISTRIBUTION OF CUMACEANS IN THE MOBILE BAY ESTUARINE SYSTEM, ALABAMA,

Alabama Univ. in Huntsville. Dept. of Biological Science.

R. F. Modlin, and M. Dardeau. Estuaries ESTUDO, Vol. 10, No. 4, p 291-297, December 1987. 4 fig. 3 tab, 38 ref. Alabama Coastal Area Board contracts 80-05 and 81-03.

Descriptors: *Estuaries, *Estuarine environment, *Bays, *Crustaceans, Aquatic populations, Season-al distribution, Spatial distribution, Mobile Bay es-tuary, Alabama, Salinity.

Seasonal occurrence patterns within the Mobile Bay estuary, Alabama, of five species of cuma-

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ceans are described. Oxyurostylis smithi was most abundant, followed by Leucon americanus, Cycla-spis varians, Eudorella monodon and Almyracuma proximoculi. With the exception of the oligonaline A. proximoculi, the cumaceans encountered within the estuary are euryhaline marine species that are most abundant at the lower bay stations and that utilize the estuary only when environmental condi-tions are favorable. (Author's abstract) W88-08014

DIARRHETIC SHELLFISH POISONING IN

DIARRHETIC SHELLFISH POISONING IN NARRAGANSETT BAY, Rhode Island Univ., Narragansett. Graduate School of Oceanography. L. Maranda, and Y. Shimizu. Estuaries ESTUDO, Vol. 10, No. 4, p 298-302, December 1987. 2 fig. 1 tab, 21 ref. Office of Sea Grant, NOAA, grant R/D-9 and NIH grant GM28754.

Descriptors: "Algal toxins, "Shellfish poisoning, "Mussels, "Dinoflagellates, "Estuaries, Dinophysis, Bioassay, Narragansett Bay, Rhode Island, Pollut-ant identification, Eutrophication, Red tide.

A 2-yr survey for diarrhetic shellfish poisoning (DSP) was conducted in Narragansett Bay using the mouse assay method. The suspected causative organisms, Dinophysis spp., were monitored at the same time. Only one shellfish sample, in Sept. 1984, yielded an unequivocal positive result at a time when the dinoflagellate population was dominated when the dinottagetiate population was dominated by D. acuminata. False positive results were suspected in May, when the mussels appeared sexually matured, and in the summer of 1985, at the time of an unusual massive picoplanktonic bloom. Evidence of toxin production by D. acuminata was obtained from an almost monospecific sample; it was calculated that over 540,000 cells would be necessary to produce one mouse unit. The specificity and sensitivity of the assay method are ques-tioned and improvements for DSP detection are suggested. (Author's abstract) W88-8015

SEASONAL ABUNDANCE OF AQUATIC DIP-TERA IN TWO OLIGOHALINE TIDAL MARSHES IN MISSISSIPPI,

M. W. LaSalle, and T. D. Bishop.
Estuaries ESTUDO, Vol. 10, No. 4, p 303-315,
December 1987. 6 fig, 2 tab, 65 ref.

Descriptors: *Aquatic insects, *Diptera, *Tidal marshes, *Estuaries, *Estuarine environment, Aquatic populations, Seasonal distribution, Mississippi, Marsh plants, Population density, Redation, Salinity.

Nineteen species of Diptera from 7 families were found in monthly collections in 2 Mississippi marsh plant zones dominated by Juncus roemerianus and Spartina cynosuroides, resp. The Juncus zone was dominated by a species of Palpomyia-Bezzia complex, 2 species of Bezzia (Ceratopogonidae), Paratendipes sp., Limnophyes sp. (Chironomidae) and Thinophilus frontalis (Dolichopodidae). Palpomyia-Bezzia sp., Culicoides hollensis, Ormosia sp. (Tipulidae) and Pelastoneurus abbreviatus (Dolichopodidae) dominated the Spartina zone. Total insect density and species richness were lowest in June and July in both zones, corresponding to a pulse of adult emergence. Overall, total density was significantly higher in the Spartina zone with mean values of 165 and 245 insects/sq m for the Juncus and Spartina zones, respectively. In addition to total density, differences in abundance were apparent for a number of species between marsh apparent for a number of species between marsh zones. Patterns could be attributed to species-specoffic habitat preference, predation by aquatic pred-edition and/or by interactions of the infauna them-selves. (Author's abstract)
W88-08016

AMMONIUM REGENERATION AND BIO-MASS OF MACROZOOPLANKTON AND CTENOPHORES IN GREAT SOUTH BAY, NEW YORK, Inha Univ., Inchon (Republic of Korea). Dept. of

Oceanography.

Y. C. Park, and E. J. Carpenter. Estuaries ESTUDO, Vol. 10, No. 4, p 316-320, December 1987. 2 fig. 2 tab, 29 ref.

Descriptors: "Zooplankton, "Ctenopohores, "Ni-trogen cycle, "Estuaries, "Bays, "Biomass, "Am-monium, Nutrient regeneration, Phytoplankton, Temperature, Seasonal variation, Great South Bay, New York, Primary productivity.

The rate of zooplankton ammonium regeneration was measured in Great South Bay, Long Island, between July 1982 and May 1984. Ammonium excretion by macrozooplankton (>200 microns) ranged from 7 microgram-atoms ammonium-N/cu m/day in winter to 156 microgram-atoms ammonium-atoms ammonium-atoms ammonium-atoms ammonium-atoms ammonium-atoms ammonium excretion. m/day in winter to 156 microgram-atoms ammonium-N/cu m/day in spring. Ammonium excretion by ctenophores was greater than or equivalent to that of macrozooplankton during the period of ctenophore biomass maximum in summer and fall. The temperature coefficient for ammonium excretion was 1.74 from 2.2 to 27.5 C for macrozooplankton and 1.63 between 17 and 26 C for the ctenophores. Ammonium-N excretion by macrozooplankton and ctenophores combined accounted for 1 to 3% of phytoplankton nitrogen requirements in summer when primary productivity was high and 39% in the spring. (Author's abstract) W88-08017

NEKTON ASSEMBLAGES OF THREE TRIBU-TARIES TO THE CALCASIEU ESTUARY.

McNeese State Univ., Lake Charles, LA. Dept. of Biological and Environmental Sciences. J. D. Felley.

Estuaries ESTUDO, Vol. 10, No. 4, p 321-329, December 1987. 2 fig, 2 tab, 24 ref. U.S. Depart-ment of Energy Grant DE-FG01-83EP31111.

Descriptors: *Tributaries, *Aquatic animals, *Bayous, *Estuaries, *Estuarine environment, *Nekton, *Fish, *Invertebrates, Calcasieu estuary, Louisiana, Seasonal variation, Municipal wastes, Industrial wastes, Dredging, Channeling, Chemical wastes, Salinity, Animal populations, Aquatic populations

Nekton species were sampled monthly by seine in three waterways that feed the upper Calcasieu Estuary in Louisiana. Of the three bayous sampled, Choupique Bayou has been least modified by man. Contraband Bayou and Bayou d'Inde have been highly modified; both have been dredged and channelized, and both receive wastes from municipal sewage treatment plants. Bayou d'Inde also receives industrial waste from a large petrochemical complex. Detrended correspondence analysis was performed on a species-by-sample matrix containing numbers of individuals of all species sampled at all locations. This analysis differentiated between freshwater assemblages found in a bayou's upper reaches and estuarine assemblages found in downstream reaches, and demonstrated seasonal changes in species composition of these assemblages. The freshwater and estuarine assemblages contained some species in common. Several estuarine species appeared in high numbers throughout the bayous, moving into freshwater as postlarvae and small juveniles. These freshwater reaches comprise an important nursery area for many estuarine species including commercially important forms. and small juveniles. These freshwater reaches com-prise an important nursery area for many estuarine species, including commercially important forms. However, the value of estuarine and freshwater nursery areas is compromised by human activities. The results showed that human activities dramati-cally reduced the number of species found in a bayou and reduced the value of the bayou as a nursery area for commercially important species. (Author's abstract) (Author's abstract) W88-08018

OCCURRENCE AND DISTRIBUTION OF SHORTNOSE STURGEON, ACIPENSER BRE-VIROSTRUM, IN THE UPPER TIDAL DELA-WARE RIVER.

Southeastern Louisiana Univ., Hammond. Dept. of Biological Sciences.

For primary bibliographic entry see Field 5C.

SEDIMENT NUTRIENT FLUXES IN A TIDAL FRESHWATER EMBAYMENT, Waterways Experiment Station, Vicksburg, MS.

C. F. Cerco.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 255-260, April 1988. 8 fig, 3 tab, 10 ref. NSF Grant CEE-8307627.

Descriptors: *Sediments, *Tidewater, *Water analysis, *Cycling nutrients, Eutrophication, Model studies, Mathematical studies, Ammonium, Nitrates, Phosphate, Water temeprature, Hydrogen ion concentration, Chlorophyll A, Sediment-water interfaces.

Sediment-water exchanges of ammonium, nitrate, and phosphate are incorporated into a eutrophication model of Gunston Cove, Virginia. The extion model of Gunston Cove, Virginia. The ex-change rates are obtained from laboratory measurements and are modeled as empirical functions of temperature, concentration, and pH. Simulation of the period from June 1 to September 30, 1983, indicates nitrogen, phosphorus, and chlorophyll 'a are correctly modeled only when the sediment-water nutrient exchanges are taken into account. (Author's abstract) (Author's abstract) W88-08030

DESIGNATION OF WETLANDS BY WEIGHT-ED AVERAGES OF VEGETATION DATA: A PRELIMINARY EVALUATION,

North Carolina State Univ. at Raleigh. Dept. of

For primary bibliographic entry see Field 2H. W88-08046

DISPERSAL-MEDIATED COEXISTENCE OF MUD SNAILS (HYDROBIDAE) IN AN ESTU-

Munich Univ. (Germany, F.R.). Zoologisches Inst. H. R. Siegismund, and J. Hylleberg. Marine Biology MBIOAJ, Vol. 94, No. 3, p 395-402, April 1987. 4 fig, 1 tab, 25 ref.

Descriptors: *Distribution patterns, *Snails, *Estuarine environment, *Population dynamics, *Species composition, Spatial distribution, Annual distribution, Mud, Kysing Fjord estuary Denmark,

The distribution of the mud snails Hydrobia ventrosa (Montagu), H. neglecta Muus, and Potamopyrgus jenkinsi (Smith) was studied in the Kysing Fjord estuary, Denmark, from November 1977 to Pebruary 1979. The hydrobiids show habitat selection with regard to salimity but coexist in large areas of the estuary: P. jenkinsi at the innermost parts of the estuary together with H. ventrosa, with the latter species extending its distribution further to the mouth of the estuary, where H. neglecta dominates. H. ventrosa and H. neglecta are the only species that have permanent populations in the estuary. P. jenkinsi dies out in the estuary in the winter, but recolonizes there from a small river in the spring and builds up a population estuary in the winter, our recoionizes there from a small river in the spring and builds up a population in the innermost parts of the estuary during the summer. H. ventrosa and H. neglecta coexist in the middle part of the estuary due to continued dispersal into this area. (Author's abstract) W88-88057

SPAWNING AREAS AND SEASONS OF THE SPRAT (SPRATTUS SPRATTUS LINNAEUS, 1758) IN THE RIA OF VIGO (GALICIA, W SPAIN) (SPORTS OF AREAS DE PUESTA DEL ESPADEN (SPRATTUS SPRATTUS LINNAEUS, 1758) EN LA RIA DE VIGO, GALICIA),

Instituto de Investigaciones Marinas, Vigo (Spain).
M. J. Ferreiro, and U. Labarta.
Investigacion Pesquera IPESAV, Vol. 51, No. 3, p
339-350, September 1987. 5 fig. 18 ref. CAICYTCSIC Project No. 23113-05.

Descriptors: *Fish, *Sprat, *Spawning, *Popula-tion dynamics, *Reproduction, Temperature ef-fects, Ichthyoplankton, Salinity, Spain.

Monthly ichthyoplankton cruises were made in the Ria of Vigo from September 1979 to April 1984.

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Sprat eggs were the most abundant in these cruises with densities up to 5218 eggs/10 sq m. The Ria of Vigo is an important spawning area for this species. The spawning season lasts from late autumn to spring, with temperature of the water of 13-14 deg C. Sprat eggs were found in all areas of the ria and seem unaffected by salinity differences. Sprat eggs were found mostly between 10 and 20 meters death (Author) extracts. depth. (Author's abstract) W88-08087

HYDROGRAPHY OF THE EBRO DELTA BAYS (HIDROGRAFIA DE LAS BAHIAS DEL

DELTA DEL EBRO), Instituto de Ciencias del Mar, Barcelona (Spain). J. Camp, and M. Delgado. Investigacion Pesquera IPESAV, Vol. 51, No. 3, p 351-369, September 1987, 9 fig. 1 tab, 8 ref. CAICYT-CSIC Project AC 16/84.

Descriptors: *Deltas, *Bays, *Hydrography, *Estuaries, *Salinity, *Saline-freshwater interfaces, Groundwater movement, Hydrology, Limnology, Ebro Delta, Seasonal variation, Storms, Water

Ebro Delta bays are like salt-wedge estuaries, in which the sea water penetrates as a salt wedge along the bottom into the estuary and the low salinity water tends to flow outwards over the surface. The two bays show thermal oscillations greater than those of the adjacent sea and the salinity is, in general, less than Mediterranean water. The lateral fresh water inflow (through a series of channels) causes a preferential low salinity distribution on this margin. Stratification situations predominate, although sometimes (mainly in Ebro Delta bays are like salt-wedge estuaries, in predominate, although sometimes (mainly in winter) the water column is uniform, due to low winter) the water column is uniform, due to low discharge of fresh water or to wind induced mixing. Fangar, the small bay, shows short period fluctuations (1-2 days), while in Alfacs, appreciable hydrographic changes occur in time periods of about 10-20 days, except those due to strong storms. The significance of groundwater seepage to the hydrography of the bays, and alternative cyclic sequences of inflow and outflow are discussed. (See also W88-08091) (Author's abstract) W88-08091.

PHYTOPLANKTON COMPOSITION IN THE RIA OF PONTEVEDRA (NW SPAIN) (COMPO-SICION DEL FITOPLANCTON DE LA RIA DE

PONTEVEDRA (NO DO ESPANAI), Instituto de Investigaciones Marinas, Vigo (Spain). F. G. Figueiras, and F. X. Niell. Investigacion Pesquera IPESAV, Vol. 51, No. 3, p 371-409, September 1987. 9 fig. 9 tab, 14 ref.

Descriptors: *Diatoms, *Red tide, *Phytoplankton, *Species composition, *Population dynamics, Statistical methods, Diatoms, Nutrients, Pontevedra,

Three important sources of variation have been Three important sources of variation have been identified in phytoplankton samples from the Ria of Pontevedra, using principal component analysis. Dinoflagellates and both large and small centric diatoms were associated with great physical stratification. Larger centric diatoms and some pennate diatoms were associated with more turbulent regimes. A red tide was associated with moderate stratification and with high concentrations of remineralized nutrients. A certain degree of betermineralized nutrients. A certain degree of hetero-trophy was found in the inner part of the Ria. This might have been detected in the whole Ria in the last stages of succession if had it not been masked by the red tide. (Author's abstract) W88-08089

ICHTHYOPLANKTON OF THE ALBUFEIRA LAGOON (1984/1985), Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal).

A. P. O. Duarte. Investigacion Pesquera PESAV, Vol. 51, No. 3, p 411-426, September 1987. 8 fig, 4 tab, 7 ref, 2 append.

Descriptors: *Fish eggs, *Coastal waters, *Species composition, *Reproduction, *Seasonal variation,

*Lagoons, *Estuaries, *Zooplankton, Biomass, Ichthyoplankton, Aquatic habitats, Aquatic an-mals, Albufeira lagoon, Dissolved oxygen, Anaero-bic conditions, Portugal, Stratification, Urbaniza-

The Albufeira lagoon is a coastal ecosystem situated on the western coast of Portugal. This system is surrounded by dunes, presenting disordered urban-ization and largely destroyed vegetation. Abufeira Lagoon lost contact with the ocean for the months of February and March. In that period there was on retriding aim whatch, in that period there was an enrichment of dissolved oxygen in the surface waters, while the deep layers were practically anoxic. There was also a greater stratification of the water column. Fish eggs and larvae were colthe water column. Fish eggs and larvae were con-lected monthly during a period of 13 months in Albufeira Lagoon (September 1984 to September 1985). The species composition, abundance, annual occurrence and spatial variation are analyzed. The occurrence and spatial variation are analyzed. The results showed a clear contrast between down-stream and upstream zones, places with different ecological conditions. The anchovy is the most abundant species in the lagoon with a preferred spawning area in the upstream zone, known as the 'small lagoon'. (Alexander - PTT) W88-08090

ABUNDANCE AND DISTRIBUTION OF DIS-SOLVED INORGANIC NUTRIENTS IN THE EBRO DELTA BAYS (ABUNDANCIA Y DIS-TRIBUCION DE NUTRIENTES INORGANI-COS DISUELTOS EN LAS BAHIAS DEL DELTA DEL ERBO). DELTA DEL EBRO),

Instituto de Ciencias del Mar, Barcelona (Spain). For primary bibliographic entry see Field 5B.

SEASONAL AND SPATIAL DISTRIBUTION OF PHYTOPLANKTON IN THE RIA OF PONTEVEDRA (NW SPARIN) (DISTRIBUCION ESTACIONAL Y ESPACIAL DEL FITOPLANCTON EN LA RIA DE PONTEVEDRA (NO DE ESPANA)),

ESPANAD, Instituto de Investigaciones Marinas, Vigo (Spain). F. G. Figueiras, and F. X. Niell. Investigacion Pesquera IPESAV, Vol. 51, No. 2, p 293-320, June 1987. 6 fig, 2 tab, 22 ref.

Descriptors: *Coastal waters, *Bays, *Water pollu-Descriptors: "Coastal waters, "Bays, "Water pollu-tion sources, 'Red tide, "Phytoplankton, "Biomass, "Seasonal variation, Cycling nutrients, Species composition, Aquatic plants, Taxonomy, Morphol-ogy, Spatial distribution, Ria of Pontevedra, Spain,

The annual cycle of phytoplankton in the ria of Pontevedra has been studied. The total abundance, and that of the more important groups, reveals an annual regime typical of temperate waters influenced by upwelling. The course of succession is interrupted by the injection of nutrients and by turbulence. Oliogotrich ciliates and small species of phytoplankton reach maximal numbers at times and in places where stability is greatest. An enand in places where stability is greatest. An en-larged species list is provided for the area. This list emphasizes the importance of naked flagellates. The red tide of October (1980) was dominated by Olisthodiscus luteus. As there is some controversy concerning the taxonomy of this species, a short description of the morphology is presented. (Author's abstract) W88-08092

FORMATION OF LONGITUDINAL FRONTS IN A COASTAL PLAIN ESTUARY, Virginia Inst. of Marine Science, Gloucester Point. L. M. Huzzey, and J. M. Brubaker. Journal of Geophysical Research JGRCEY, Vol. 93, No. C2, p 1329-1334, February 15, 1988. 8 fig.

Descriptors: *Estuaries, *Tidal rivers, *Water circulation, *Density gradients, Coastal plains, Shoals, Channels, Water currents, Tides, Tidal currents, Density, Advection, York River, Chesapeake Bay, Virginia.

Longitudinal estuarine fronts, aligned parallel to the axis of the estuary, are characteristic of the

York River, a Chesapeake Bay tributary in Virginia. The surface-convergent circulations associated with these features bring foam and other floating debris into a line along the position of the front. The time scale for front genesis and decay is of the order of hours; they are usually located at the inner edge of the shoals or over the main channel. Field measurements have shown marked intratidal differences in density and current speeds across this estuary. These can be correlated with changes in depth and the strength of the advective processes. Differential advection between the channel and es. Differential advection oetween the challes and shoal regions, when acting upon a constant longi-tudinal density gradient, is shown to be of suffi-cient magnitude to generate strong lateral density gradients, and thus form fronts, at particular times vithin the tidal cycle. (Author's abstract) W88-08136

'OVERSHOOTING' EFFECTS DUE TO HY-DRODISPERSIVE MIXING OF SALTWATER LAYERS IN AQUIFERS,

Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Matematik und Mechanik. For primary bibliographic entry see Field 2F.

SPECTRAL ANALYSIS OF STORM SURGE IN HONG KONG VICTORIA HARBOUR,

Norton Christensen, Salt Lake City, UT. Diamond Technology Center. S.K.W. Tou, and K. Arumugam.

Advances in Water Resources AWREDI, Vol. 9, No. 3, p 178-183, September 1986. 7 fig, 6 ref.

Descriptors: *Mathematical models, *Hydrologic models, *Storm surges, *Hydrographs, *Harbors, *Tidal amplitude, Harbor oscillations, Hong Kong.

Based on a linear model the dynamic characteristics of Victoria Harbour (Hong Kong) were obtained by means of spectral analysis of the storm surge hydrographs. The harbor is an ideal one which has a small gain factor and a flat response in the frequency range 0 to 0.00006 Hz. The power spectra possess the narrow band features which indicate that the periodic components associated with tidal motions are predominant over the random components. The power spectrum corresponding to a frequency of 0.000023 Hz is likely to be associated with the tides. The peaks in the power spectra at zero frequency suggest that the pumping mode of oscillations is dominant in a storm surge. This mode of oscillations represents the temporal variations in mean sea level. To demonstrate the full potential of the present model, more case studies should be conducted when surge as well as non-surge data are available. (Author's abstract) W88-08186

SWELL MODEL OF THE GERMAN BIGHT. Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).

J. W. Dippner. Coastal Engineering COENDE, Vol. 11, No. 5/6, p 527-538, December, 1987. 6 fig, 16 ref.

Descriptors: *Path of pollutants, *Mathematical models, *Bights, *German Bight, *Water currents, *Tides, *Waves, Model studies, Energy, Momentum transfer, Shallow water, Mathematical equations, Engineering, Coastal engineering.

A numerical model was developed to investigate the contribution of wave-induced currents to the tidal residual circulation in the German Bight. The momentum transfer by swell decaying to the mean circulation is calculated, including wave-current interaction without refraction. The model couples deep-water and shallow-water energy dissipation mechanisms such as wave attenuation and wave breaking. The model also computes wave set-up, wave set-down, and a longshore current. The pure wave-induced circulation is calculated, as well as the residual circulation due to the interaction be-tween waves and tide. Results suggest that the wave-induced currents can be neglected for the

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calculation of transport of near-surface pollutants. (Author's abstract) W88-08202

CONSERVATION PROBLEMS AND MANAGE-MENT OPTIONS IN ESTUARIES: THE BOT RIVER ESTUARY, SOUTH AFRICA, AS A CASE-HISTORY FOR MANAGEMENT OF CLOSED ESTUARIES,

Cape Town Univ. (South Africa). Dept. of Zoolo-

gy. R. Bally.

Environmental Conservation EVCNA4, Vol. 14, No. 1, p 45-51, Spring 1987. 5 fig, 2 tab, 23 ref.

Descriptors: *Estuaries, *Water conservation, *Management planning, Coastal waters, Blind estuaries, Lakes, Vleis, Limnology, Lagoons, Bot River, South Africa.

Closed (or 'blind') estuaries are common features. throughout the world, of areas experiencing mark-edly seasonal rainfall. The Bot River vlei is a closed estuary which faces considerable problems of management and conservation. For the past 100 years or more, the estuary has opened to the see every 2-5 years by artificial means, resulting in a very great variability of physical conditions and a very great variability of physical conditions and a concomitantly low diversity of organisms able to occupy the estuary permanently. Nevertheless, those species that do exist in the Bot River vlei are mostly estuarine species. The estuary is separated from the sea by a dune barrier that is in the process of widening, and this, together with an overflow channel to a neighboring estuary, suggests that if the Bot River vlei were left to its own devices, it would turn into a freshwater system within a few years. The Bot River vlei is therefore a system that could be managed either as a partial estuary or as a freshwater coastal lake. The merits and demerits of freshwater coastal lake. The merits and demerits of these options are discussed, as are the problems faced with having any single option implemented, due to the development of a number of interest groups with partially conflicting demands and desires. The case of the Bot River vlei illustrates the problems and conflicts that may arise when attempts are made to manage closed estuaries and lagoons, and is of interest for the management of comparable situations in other parts of the world. (Sand-PTT) W88-08216

FORESEEABLE FLOODING AND DEATH OF COASTAL WETLAND FORESTS,

Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments

R. D. DeLaune, W. H. Patric, and S. R. Pezeshki. Environmental Conservation EVCNA4, Vol. 14, No. 2, p 129-133, Summer 1987. 5 fig, 1 tab, 19 ref.

Descriptors: *Wetland forests, *Swamps, *Coastal waters, *Deltas, *Floods, *Sedimentation rates, Submergence, Deterioration, Oak, Cypress, Water level, Sea level, Missispip River, Saline water intrusion, Greenhouse effect.

Relationships between sedimentation, submergence, and deterioration of a Mississippi River deltaic-plain coastal wetland forest were investigated. Measured sedimentation rates (0.63 + or 0.35 cm per yr) as determined by cesium-137 chaing were considerably less than the rapid increase in water level (c. 1.36 cm per yr). Transplanted seedlings of Quercus lyrata (Overcup Oak) and of Taxodium distichum (Bald Cypress) survived only on the most elevated natural ridge in vived only on the most elevated natural ridge in this swamp-forest. The combined effects of rapid subsidence, custatic sea-level rise, and accompany-ing salt-water intrusion, could destroy much of these swamp-forests and cause major habitat changes in this ecologically important region. Re-sults presented may represent future conditions for many forested coastal regions of the world, which may experience a rapid rise in water level as a result of the predicted 'greenhouse' warming, con-sequent melting of ice, and accelerated world-wide sea level rise. (Sand-PTT) INDUSTRIAL DEVELOPMENT EFFECTS ON THE ECOLOGY OF A PACIFIC MEXICAN ES-Centro de Investigacion Cientifica y de Educacion

Superior de Ensenada (Mexico). For primary bibliographic entry see Field 4C. W88-08219

COASTAL EUTROPHICATION IN SWEDEN: REDUCING NITROGEN IN LAND RUNOFF, Halland County Administrative Board, Halmstad (Sweden).

For prima W88-08227 ary bibliographic entry see Field 5G.

FLUIDIZATION OF MUD IN ESTUARIES, Australian Inst. of Marine Sciences, Towns For primary bibliographic entry see Field 2J. W88-08243

BEHAVIOUR AND ECOLOGICAL IMPORTANCE OF A MUD SNAIL (ILYANASSA OBSOLETA) POPULATION IN A TEMPERATE MACROTIDAL ESTUARY, Bedford Inst. of Oceanography, Dartmouth (Nova Scotia), Dept. of Fisheries and Oceans.

P. J. Cranford.

Canadian Journal of Zoology CJZOAG, Vol. 66, No. 22, p 459-466, February 1988. 5 fig, 2 tab, 45

Descriptors: *Aquatic life, *Aquatic animals, *Estuaries, *Intertidal areas, Ecosystems, Behavior, Reproduction, Mud snail, Aquatic plants, Macroalgae, Detritus, Seasonal variation, Bay of Fundy, Canada, *Predation.

A population of Ilyanassa obsoleta was sampled during the 8-months period when the during the 8-monthy period when they are present in the intertidal zone in the Southern Bight of in the intertidal zone in the Southern Bight of Minas Basin, Bay of Fundy. Mud snails were first observed in April, and spawning took place in late May and early June. Flesh weight increased between May and November, with the highest growth rates recorded during August and September. During November the population returned to the subtidal zone, where energy reserves are partially utilized during winter. Clustering and differential babiest selection (self march er mud file tially utilized during winter. Clustering and differential habitat selection (salt marsh or mud flat) within size classes resulted in large spatial variations in density, standing stock, and production. Production by I. obsoleta averaged 1.1 g C per square meter during their stay in the intertidal zone. The supply of carbon from epibenthic microalgae is insufficient to meet the requirements of this population. Detritus derived from Spartina is believed to be an important additional source of carbon, I. obsoleta is not a major prey item of any of the better known predators in this region. Their importance to the intertidal community results from the direct (predation) and indirect (competition, disturbance, nutrient regeneration, and bioturtion, disturbance, nutrient regeneration, and biotur-bation) influence of their presence on sedimentary microbial process and the resident benthic flora and fauna. (Author's abstract) W88-08302

FIELD VERIFICATION OF WAVE EQUATION TIDAL DYNAMICS IN THE ENGLISH CHAN-NEL AND SOUTHERN NORTH SEA,

Thayer School of Engineering, Hanover, NH. F. E. Werner, and D. R. Lynch. Advances in Water Resources AWREDI, Vol. 10, No. 3, p. 115-130, September 1987. 29 fig, 16 ref, append. National Science Foundation Grant CEE-8352226.

Descriptors: *Estuaries, *Coastal waters, *Tidal waves, *Tides, *Tidal currents, Dynamics, Finite element method, Wave equation, Simulation analysis, Mathematical methods, English Channel, North Sea. Field tests.

A simulation of the tides and tidal currents was carried out for the English Channel and southern North Sea using the lumped, implicit Wave Equation formulation on linear finite elements. Comparisons to tide gauge data and current meter records without any attempt at fine-tuning the

solution showed good agreement overall. The so-lution of the 2-D, inviscid shallow water equations (no horizontal diffusion of momentum included for numerical stability or otherwise) can provide an accurate solution to the problem of tidal propaga-tion. (Sand-PTT) W88-08345

SIMULATION OF TIDAL FLOW IN THE SOUTHERN PART OF THE NORTH SEA AND THE ENGL H CHANNEL, Notre Dame Univ., IN. Dept. of Civil Engineer-

ing. W. G. Gray, J. Drolet, and P. E. Kin

Advances in Water Resources AWREDI, Vol. 10, No. 3, p 131-137, September 1987. 13 fig, 13 ref. National Science Foundation Grant CEE-8419366.

Descriptors: *Estuaries, *Coastal waters, *Model studies, *Tides, *Tidal currents, *Simulation analysis, Mathematical models, North Sea, English Channel, Finite difference methods, Finite element

Prediction of circulation in estuaries and coastal Prediction of circulation in estuaries and coastal regions presents a challenge to numerical modelers. To obtain an operational simulation model, the spatial and temporal dependence of the governing equations must be approximated. The development of spatial approximations has proceeded essentially within the framework of two classes of approximations: finite differences; and, finite elements. This paper contains a formulation of the governing wave equations, a presentation of numerical approximations, a short description of the data set and a comparison between measured and predicted proximations, a short description of the data set and a comparison between measured and predicted data for tidal flow in the southern part of the North Sea and the English Channel. The comput-ed results show good agreement in many cases with measured data, but remaining discrepancies warrant further search for higher accuracy in nu-merical simulation methods as well as in field measurement techniques. (Sand-PTT) W88-08346

MODEL FOR TIDES AND CURRENTS IN THE ENGLISH CHANNEL AND SOUTHERN NORTH SEA,

Geological Survey, Tacoma, WA. R. A. Walters.

Advances in Water Resources AWREDI, Vol. 10, No. 3, p 138-148, September 1987. 20 fig, 2 tab, 18

Descriptors: *Estuaries, *Coastal waters, *Water currents, *Model studies, *Tides, *Tidal currents, *Finite element method, Mathematical models, Simulation analysis, English Channel, North Sea.

The amplitude and phase of 11 tidal constituents for the English Channel and southern North Sea are calculated using a frequency domain, finite element model. The governing equations - the shallow water equations - are modified such that sea level is calculated using an elliptic equation of the Helmholtz type followed by a back-calculation of velocity using the primitive morientum equations. Triangular elements with linear basis functions are used. The modified form of the governing equations provides stable solutions with little numerical noise. In this field-scale test problem, the model noise to produce the details of this structure of 11 tidal constituents. (Author's abstract) W88-08347

MODELLING OF DISPERSION IN 2-D TIDAL FLOW OVER AN UNEVEN BED, Technische Hogeschool Delft (Netherlands). Dept.

of Civil Engineering.

J. P. T. Kalkwijk.

Advances in Water Resources AWREDI, Vol. 10,
No. 3, p 164-172, September 1987. 5 fig, 11 ref,

Descriptors: *Channel morphology, *Coastal waters, *Dispersion, *Tidal flow, *Tidal hydraulics, Mathematical models, Taylor approximation, Advection-diffusion equation, Dispersion.

Estuaries—Group 2L

This paper deals with the effective mixing by topographic induced velocity variations in 2-D tidal flow. This type of mixing is characterized by tidally-averaged dispersion coefficients, which depend on the magnitude of the depth variations with respect to mean depth, the velocity variations and the basic dispersion coefficients. The analysis is principally based on a Taylor type approximation (large clouds, small concentration variations) of the 2-D advection diffusion equation and a 2-D velocity field that behaves harmonically both in time and in space. Neglecting transient phenomena and applying time and space averaging the effective dispersion coefficients can be derived. Under certain circumstances it is possible to relate the velocity variations to the depth variations, so that inally effective dispersion coefficients can be determined using the power spectrum of the depth variations. Attention is paid to the modelling of sub-grid mixing in case of numerical integration of the advection-diffusion equation. It appears that the dispersion coefficients taking into account of the sub-grid mixing are not only determined by the velocity variations within a certain grid cell, but also by the velocity variations at a larger scale. (Author's abstract)

STUDIES OF TIDAL FLAT ENVIRONMENTS WITH LANDSAT MSS DATA, Roskilde Universitetscenter (Denmark).

Roskilde Universitetscenter (Denmark). S. Folving. IN: Europe from Space. Proceedings of an ESA/ EARSeL Symposium held in Conjunction with EARSeL's General Assembly at the Technical University of Denmark, Lyngby, June 25-27, 1986. Report No. SP-258, December 1986. p 289-293, 8 fig, 4 ref.

Descriptors: *Tidal flats, *Landsat, *Data interpretation, *Remote sensing, *Satellite technology, Maps, Turbidity, Mapping.

Multitemporal Landsat data has been used to classify and map tidal flats in accordance with the main sediment types found by field work. By combining imagery from 1976 with imagery from 1981, and by means of principal component analysis, it was possible to detect major changes in the sandy tidal flats. Changes in the silty and clayey tidal flats seem rather hard to detect. Multispectral measurements from aircraft, 150 m above the surface. recorded concurrently with collection of measurements from aircraft, 190 m above the sur-face, recorded concurrently with collection of water samples were used to calibrate the satellite data. Multivariate statistical analysis were per-formed, and the results made it possible to map the spatial variation in concentrations of suspended matter. (See also W88-08470) (Author's abstract) W88-08481

COMMUNITY STRUCTURE, Norsk Inst. for Vannforskning, Oslo. For primary bibliographic entry see Field 5C. W88-08485

EFFECTS OF DIESEL OIL ON COMMERCIAL BENTHIC ALGAE IN NORWAY, Norsk Inst. for Vannforskning, Oslo. For primary bibliographic entry see Field 5C. W88-08486

SETTLEMENT, GROWTH AND COMMUNITY STRUCTURE ON GRANITE CHIPS. A COMPARISON BETWEEN FOUR BASINA AT S.E.S. AND A SHELTERED LOCALITY IN THE OSLOFJORD,

Uppsala Ionospheric Observatory (Sweden). For primary bibliographic entry see Field 5C. W88-08487

PÓPULATION GENETICS OF LITTORINA LITTOREA AT SOLBERGSTRAND, For primary bibliographic entry see Field 5C. W88-08489

POPULATION GENETICS OF MYTILUS EDULIS AT SOLBERGSTRAND.

For primary bibliographic entry see Field 5C. W88-08490

CARCINUS MAENAS (L.) IN THE FOUR ROCK BOTTOM BASINS AT SOLBERGSTRAND EX-PERIMENTAL STATION,

PERIMENIAL STATION, Uppsala Ionospheric Observatory (Sweden). K. Moe, O. A. Follum, and E. Lystad. IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, Decem-ber 1984. p 119-128, 4 fig. 2 tab, 8 ref.

Descriptors: *Predation, *Crabs, *Solbergstrand, *Norway, *Population dynamics, Ecological effects, Mytilus Seasonal variation, Algae.

fects, Mytilus Seasonal variation, Algae.

The number of predators inside the basins at Solbergstrand Environmental Station (S.E.S.) are small. They are limited by a planktonic input from the pipelines, or by their own ability to increase the present population. One of the most conspicuous predators here is the shore crab, Carcinus maenus, which influences the community structure. Carcinus predates on young Littorina littorea and newly settled Mytilus edulis, and is probably eating or at least disturbing newly settled barnacles and other small organisms on the substrate by scavenging. One of the most important contributions expected from the crabs is their ability to disturb or to keep the periwinkle population down. An interaction is suspected to be taking place between Littorina grazing and Carcinus predation, and the aim of this work was to estimate the crab population in each basin for a comparison with the Littorina population and the community structure of benthic organisms. An increase was expected in the number of crabs in each basin during the summer when the newly hatched individuals grew larger and were easier to sample. After the last moulting in autumn, according to previous work. larger and were easier to sample. After the last moulting in autumn, according to previous work, some of the oldest generation would die and the population size would decrease. These assumptions seem to fit the data for High Oil (HO) and C4 seem to fit the data for High Oil (HO) and C4 (control 4). Great variations of numbers were found in C2 (control 2), and have two explanations. One is the artificial wall with possibilities for the crabs to migrate below or through to the chamber behind. The other is the very dense cover of algae, mainly Fucus serratus, at the bottom of the basin. The very low number of crabs found in the September sampling in LO is partly due to the tendency of some crabs being buried in the sparse sediment, and the accumulation of algae fragments in one end of the basin. (See also W88-08482) (Lantz-PTT) W88-084891 W88-08491

SUBLETHAL BIOLOGICAL EFFECTS AND RECOVERY OF MUSSELS (MYTILUS EDULIS) FOLLOWING CHRONIC EXPOSURE TO PETROLEUM HYDROCARBONS: PHYSIOLOGICAL RESPONSES, Institute for Marine Environmental Research, Butternout Company (1997)

Plymouth (England).
For primary bibliographic entry see Field 5C.
W88-08492

ORGANIC ENRICHMENT OF SUBTIDAL SEDIMENTS WITH POWDERED ASCHO-PHYLLUM NODOSUM: AN EXPERIMENTAL STUDY IN THE SOFT BOTTOM MESOCOSM AT SOLBERGSTRAND, For primary bibliographic entry see Field 5B. W88-08495

SOLITARY BRYOZOA MONOBRYOZOON LI-MICOLA (CTENOSTOMATA), A COMPARI-SON OF MESOCOSM AND FIELD SAMPLES

SON OF MESOLOSM AND FIELD SAMPLES FROM THE OSLOFJORD,

J. A. Berge, H. P. Leinaas, and K. Sandoy.

Ili: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, December 1984. p 231-251, 2 fig. 2 tab, 8 ref.

Descriptors: *Bryozoa, *Fjords, *Norway, *Ecology, *Sediments, Ecosystems, Population dynamics, Mesocosms, Oslofjords, Biological studies.

Subtidal sediment from the Oslofjord was sampled Subtidal sediment from the Oslofjord was sampled and transported in boxes into an indoor mesocosms to establish a soft bottom community for experimental studies. After 7 months, 662 individuals of the solitary pryozoan Monobryozoon limicola were found inside the mesocosm in 6 of 24 cores (inner diameter 6 cm). This is the first record of M. limicola in Norway. The mean number of this species per corer was 27.5 with a highly aggregated distribution. The number of other organisms found in the cores where M. limicola were found was significantly lower than in cores where M. limicola was absent. M. limicola was not found at the site from where the sediment in the mesocosm originated. It is proposed that the high density of originated. It is proposed that the high density of this species in the mesocosm in a function of reunis species in the mesocosm in a function of reduced competition, predation, or disturbance from other organisms which were more vulnerable to the environmental conditions in the mesocosm and/or the method of sampling and transportation. (See also W88-08482) (Author's abstract) W88-08496

GRAYS HARBOR ESTUARY MANAGEMENT

For primary bibliographic entry see Field 5G. W88-08512

NEW HAMPSHIRE COASTAL PROGRAM OCEAN AND HARBOR SEGMENT AND FINAL ENVIRONMENTAL IMPACT STATE-

National Oceanic and Atmospheric Administra-tion, Washington, DC. Office of Coastal Zone Management.

For primary bibliographic entry see Field 5G. W88-08513

EFFECTS OF ELEVATED CO2 ON CHESA-PEAKE BAY WETLANDS: II. GAS EXCHANGE AND MICROENVIRONMENT IN OPEN TOP

Smithsonian Institution, Edgewater, MD. Chesa-peake Bay Center for Environmental Studies. For primary bibliographic entry see Field 2H. W88-08541

GLOBAL TRENDS IN THE NATURE OF OR-GANIC MATTER IN RIVER SUSPENSIONS, Hamburg Univ. (Germany, F.R.). Geologisch-Pa-laeontologisches Inst. und Museum. For primary bibliographic entry see Field 2E. W88-08559

MEASUREMENTS OF CHLOROPHYLLA FROM PHYTOPLANKTON USING ETHANOL AS EXTRACTION SOLVENT,

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab. For primary bibliographic entry see Field 2H. W88-08590

SPECTROFLUOROMETRIC DETERMINA-TION OF CHLOROPHYLLS AND PHEOPHY-

Laboratoire Arago, Banyuls-sur-Mer (France).

J. Neveux, and M. Panouse.
Archiv fuer Hydrobiologie AHYBA4, Vol. 109,
No. 4, p 567-581, June 1987. 4 tab, 27 ref. URA
117, GRECO 34, RCP 598.

Descriptors: *Marine environment, *Fluorescence, *Pheophytins, *Chlorophyll, *Analytical methods, *Spectrophotometry, Measuring instruments, Phytoplankton, Performance evaluation, Acidification, Wavelength, Chlorophyll a, Chlorophyll c, Pheophytin a, Pheophytin b, Pheoporphytin c, Pheophytin b, Pheophytin b,

The use of selective fluorescence excitation and emission wavelengths in the determination of chlorophylls and pheophytins in crude acetone ex-tracts of marine phytoplankton is tested. The method does not include acidification. Using the less expensive types of spectrophotofluorometer (non-corrected), it is necessary to have a conven-

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ient stable reference to check the instrument and to correct fluorescence measurements. However, it appears more convenient to take a reference showing excitation and emission spectra in the same wavelength range as that of chlorophyll pigments. Pheophytin-a in polymethyl-methacrylate repre-sents such a reference. Accuracy in a pigment determination is dependent on its quantum yield, its relative abundance and its spectral overlap with those of other pigments present. For marine sam-ples, better assessment for chlorophyll-a, -b and -c pies, better assessment for cinotophylia, do and c-can be expected using spectrofluorometry than by more traditional methods. Good accuracy for phe-ophytina is also found when it represents at least 10% of the total chlorophylla + pheophytina. Weak or no accuracy in pheophytin-b and pheo-porphyrinc concentrations is observed. (Author's

DETERMINATION OF TECHNETIUM-99 IN THE BROWN MARINE ALGA FUCUS SPIRA-LIS COLLECTED ALONG THE BELGIAN

Centre d'Etude de l'Energie Nucleaire, Mol (Bel-

gium). For primary bibliographic entry see Field 5A. W88-08607

METHODOLOGICAL APPROACH TO THE EVALUATION OF DIFFUSION COEFFICIENTS OF RADIONUCLIDES IN MARINE

COASTAL SEDIMENTS,
Pavia Univ. (Italy). Dipt. di Chimica Generale.
For primary bibliographic entry see Field 5A.
W88-08609.

RADIONUCLIDES IN COASTAL AND ESTUA-RINE SEDIMENTS FROM WIRRAL AND LAN-

Liverpool Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 5A. W88-08609

STUDIES ON THE MOTION OF GROUND WATER WITH DISPERSION IN COASTAL AQUIFERS: III. DISPERSIVITIES IN NAKA AND KIKI RIVER ESTUARIES, (IN

JAPANESE), Ehime Univ., Matsuyama (Japan). Dept. of Ocean **Engineering**

For primary bibliographic entry see Field 2F. W88-08632

STUDIES ON THE MOTION OF GROUND WATER WITH DISPERSION IN COASTAL AQUIFERS: IV. NUMERICAL ANALYSIS BASED ON TWO-DIMENSIONAL UNSTEADY STATE MODEL, (IN JAPANESE),

me Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.
W88-08637

MACROBENTHIC FAUNAS OF TWO BRACK-ISH LAGOONS WITH DIFFERENT SALINITY IN KAMIKOSHIKI ISLAND, KAGOSHIMA PREFECTURE, (IN JAPANESE),

Tokyo Univ. (Japan). Dept. of Geography. M. Yamamuro. Japanese Journal of Limnology RIZAA, Vol. 48, No. 3, p 177-186, July 1987. 8 fig, 3 tab, 43 ref.

Descriptors: *Benthic fauna, *Brackish water, *Lagoons, Kamikoshiki Island Japan, Midges, Oligo-chaetes, Salinity, Marine animals, Population density, Seasonal variation, Mollusks, Polychaetes, Bi-

Quantitative seasonal samplings of macrobenthos were carried out in two brackish lakes with differ-ent salinities on Kamikoshiki Island, Kagoshima Prefecture. At Lake Kazakiike, where chlorinity of the water was around 1 ppt, macrobenthic fauna was comprised mostly of chironomid larvae and oligochaetes, which were presumably fresh form, and some brackish and one marine species were

added to the fauna. At Lake Kaiike, where surface water usually showed 10 ppt chlorinity, all species were marine. The population density of macrobenthos was high in autumn and low in summer in both lakes. Dominant species changed at each both lakes. Dominant species changed at each depth among bivalves and polychaetes in Lake depth among bivalves and polychaetes in Lake Kaiike. Common brackish species were character-istically absent in both Lake Kazakiike and Lake Kaiike. It is assumed that the absence of open waterways from the lakes into either fresh or marine regions was responsible for the lack of brackish species in both lakes. (Author's abstract) W88-08640

DISTRIBUTION OF PARTICULATE ORGANIC MATTER IN THE LOWER PART OF THE TAMA RIVER, (IN JAPANESE), Tokyo Metropolitan Univ. (Japan). Dept. of

Chemistry.

M. Ochiai, M. Ogino, K. Sasaki, and T. Okazawa.
Japanese Journal of Limnology RIZAA, Vol. 48,
No. 3, p 187-194, July 1987. 3 fig, 5 tab, 19 ref.

Descriptors: *Spatial distribution, *Particulate matter, *Organic matter, *Tama River, Japan, *Estuaries, Carbohydrates, Amino acids, Chlorophyll A, Salinity, Water.

Water samples obtained from the estuary of the Tama River were measured for particulate carbo-hydrates, amino acids, and chlorophyll-a by GLC hydrates, amino acids, and chlorophyll-a by GLC and HPLC. These particulate organic compounds were divided into two classes of fraction using arabinose and chlorophyll-a as markers: One fraction was supplied from the upper part of the Chofu water-intake and the other one was produced in situ by primary producers in the river water. The particulate carbohydrate and amino acid concentrations of each fraction were calculated at each sampling station. It was observed that the behavior of the particulate carbohydrates originating from the upper part of the river was different from that of the particulate Carbonyurates originating from the upper part of the river was different from that of the particulate amino acids in the estuary. The particulate carbohydrates decreased gradually from Tamagawa-Ohashi to Kawasaki and the par-ticulate amino acids decreased sharply between Daishi and Kawasaki. These two classes of compounds are considered to have a different sensitivity for salinity in the estuary. (Author's abstract) W88-08641

DISTRIBUTION OF LACTATE, PROPIO-NATE, AND ACETATE-OXIDIZING SUL-FATE-REDUCING BACTERIA IN VARIOUS AQUATIC ENVIRONMENTS, Tokyo Metropolitan Univ. (Japan). Dept. of Biol-

For primary bibliographic entry see Field 5B. W88-08648

DISTRIBUTION OF NITROGEN SPECIES AND ADSORPTION OF AMMONIUM IN SEDIMENTS FROM THE TIDAL POTOMAC

RIVER AND ESTUARY,
Geological Survey, Reston, VA.
N. S. Simon, and M. M. Kennedy.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 25, No. 1, p 11-26, July 1987. 3 fig, 5 tab, 37

Descriptors: "Nitrogen, "Nitrogen compounds, "Ammonium, "Sediments, "Bottom sediments, "Adsorption, "Tidal rivers, "Estuaries, Estuarine environment, Chemical analysis, Spatial distribu-tion, Regression analysis, Potomac River, Intersti-tial water, Potassium.

The distribution of dissolved ammonium, adsorbed ammonium, and residual, organic, and total nitro-gen was measured in Potomac River tidal, transi-tion zone, and lower estuary sediments to a depth of 66 cm. For these sediments, exchangeable ammonium, and thereby adsorbed ammonium concentrations, were determined directly using an ammonia electrode in alkaline sediment suspensions. Ammonia electrode data were comparable to data obtained by KCl extraction of fresh sediment. The conventional unitless ammonium adsorption coeffi-cient, calculated as the slope of the regression line drawn when sediment-adsorbed ammonium (mi-

cromol/g dry wt of sediment) is plotted against interstitial water ammonium (micromol/g dry wt sediment), is 1.5 for this system. When a modified ammonium adsorption coefficient is calculated from sediment-adsorbed ammonium concentrations and a ratio of interstitial water ammonium and potassium concentrations, the regression equation through the data has a zero intercept and is more nearly linear than the regression equation of data based on conventional calculations. The use of a ratio including ammonium and potassium concentrations in the interstitial water term takes into account ionic strength variations in the estuary and competition between ammonium and potassium for adsorption sites. (Author's abstract) W88-08709

RELATIONSHIP BETWEEN LIGHT ATTENU-ATION AND PARTICLE CHARACTERISTICS IN A TURBID ESTUARY, Maine State Dept. of Marine Resources, West Boothbay Harbor. For primary bibliographic entry see Field 2J. W88-08711

SEASONAL AND SPATIAL DISTRIBUTIONS OF COPPER, CADMIUM AND ZINC IN THE SEAWATER OF BLANCA BAY,

SEAWAIER OF BLANCA BAY, Instituto Argentino de Oceanografia, Buenos Aires. Lab. de Quimica Marina. For primary bibliographic entry see Field 5B. W88-08712

WETLAND LOSS AND THE SUBDELTA LIFE

North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences. For primary bibliographic entry see Field 2J. W88-08713

PLUTONIUM AND CESIUM RADIONU-CLIDES IN SEDIMENTS OF THE SAVANNAH RIVER ESTUARY,

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab. For primary bibliographic entry see Field 5B. W88-08714

HYDROCARBON GEOCHEMISTRY OF THE PUGET SOUND REGION: III. POLYCYCLIC AROMATIC HYDROCARBONS IN SEDI-

Washington Univ., Seattle. School of Oceanography. For primary bibliographic entry see Field 5B. W88-08715

DIATOM SIZE DISTRIBUTIONS AND COM-MUNITY STRATIFICATION IN ESTUARINE INTERTIDAL SEDIMENTS,

Marine and Freshwater Research Service, Guilford CT

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 2, p 193-209, August 1987. 7 fig, 5 tab,

Descriptors: *Estuaries, *Benthic flora, *Algae, *Diatoms, *Ecological distribution, *Vertical distribution, *Intertidal areas, *Sediments, *Marine sediments, Particle size, Organic matter, Porosity, Light penetration, Oxygen, Mud, Sediment-water interfaces, Aquatic habitats, Stratification, Grazing, Connecticut.

The organization of an intertidal epipelic diatom community was quantified in terms of vertical cell-size distributions within soft sediments. Microgradients of grain and organic particle sizes, percage of organics, porosity, light attenuation, oxygen distributions were measured over the top 5 mm of surface sediments. Epifluorescence microscopy and computerized planimetry showed that diatom cell size was bimodally distributed between very small and very large cells. The community was vertically stratified within the sediments with

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large numbers of small cells massed at the interface. Large cells were concentrated deeper in the microhabitat, far below light and oxygen penetration. Community organization was related to r-K selection theory, invertebrate herbivory, and sizerelated adaptations of the diatoms. (Author's abstract) W88-08716

FAUNAL CHARACTERISTICS AND SEDI-MENT ACCUMULATION PROCESSES IN THE JAMES RIVER ESTUARY

JAMES RIVER ESTUARY,
Virginia Inst. of Marine Science, Gloucester Point.
L. C. Schaffner, R. J. Diaz, C. R. Olsen, and I. L.
Larsen.

Larsen.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 2, p 211-226, August 1987. 7 fig. 3 tab, 43 ref. EPA Contract R805982-01-0 and Department of Energy Contract DE-AC05-840R21400 with Martin Marietta Energy Systems Inc.

Descriptors: *Estuaries, *Aquatic animals, *Benthic fauna, *Ecological distribution, *Sedimentation, *Sedimentation rates, *Sediment structures, Sediment crossion, Sediment transport, Deposition, Mixing, Sediment-water interfaces, Spatial distribution, Salinity, Radioisotopes, Virginia, Chesapeake Bay, James River.

The relationship between the fauna characteristics and sediment accumulation processes in the James River, VA, was studied during June 1981. Physical sedimentary and benthic biological parameters, as well as sediment structure and radionuclide profiles, were evaluated for 11 stations. Faunal distribution patterns reflected species' response to salinity changes along the estuarine gradient, but not to differences in sediment accumulation rates. Levels of bioturbation could not be predicted easily on the basis of faunal characteristics alone. Results suggest that the physical processes of erosion and deposition strongly influence the ability of macrobenthos to bioturbate sediments in this estuary. Areas of rapid deposition (> 3 cm/yr) exhibit little evidence of bioturbation, as do areas where erosion, or relatively constant physical reworking of sediments, dominate. Areas with low sediment accumulation rates (0.5-3 cm/yr) exhibit the highest levels of mixing as evidenced in X-radiographs. Estuarine organisms inhabiting soft bottoms are typically 'opportunistic', shallow-living and short-lived species, and the composition of their communities is not strongly influenced by rates of deposition. Physical reworking of sediments is most likely to occur near the sediment-water interface where reworking by shallow-living organisms is most intense. Sediment-mixing processes should be characterized using a range of approaches. The phasing of interactions among erosion, physical transport, deposition, and biological mixing must be resolved on the appropriate time scales if the mechanics of processes governing the formation of the sedimentary record are to be elucidated. (Author's abstract)

SEDIMENT ALIPHATIC HYDROCARBONS IN THE FORTH ESTUARY, Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Business Organization.

For primary bibliographic entry see Field 5B.

RECRUITMENT DYNAMICS OF METAMOR-PHOSING ENGLISH SOLE, PAROPHRYS VE-TULUS, TO YAQUINA BAY, OREGON, Oregon State Univ., Corvallis. Coll. of Oceanogra-

phy.
G. W. Boehlert, and B. C. Mundy.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 25, No. 3, p.261-281, September 1987. 7 fig, 4
tab, 73 ref. NSF Biological Oceanography Grant
OCE-80-25214.

Descriptors: *Fisheries, *Marine fisheries, *Estuarine fisheries, *Population dynamics, *Ecological distribution, *Flounders, *Fish populations, *Fish migration, *Growth stages, *Larval growth stages, *Juvenile growth stage, *Bays, *Estuaries, Diestribution, Fish, Oregon, North America, Pacific

Ocean, Spawning, Life history studies, Biological samples, Plankton, Benthic fauna, Coastal waters, Shallow water, Water currents, Tidal currents, Tides, Salinity.

English sole, Parophrys vetulus, spawn in shelf waters off the west coast of North America and early development occurs in coastal waters. Near metamorphosis, however, larvae recruit to nearshore and estuarine nursery areas, an uncommon life-history feature for a species in this region. Recruitment of larval P. vetulus to Yaquina Bay was sampled with moored nets on a weekly basis. Recruitment began during night flood tides in late February and was characterized by three peaks during the season. Planktonic recruitment continued into June, whereas benthic juveniles began to emigrate from the estuary in late May. The data suggest that two developmental stages of recruits immigrated to Yaquina Bay. The first are newly transforming larvae which enter the bay earliest within each peak of recruitment; peaks of abundance are related to onshore Ekman transport. This transport also brings larvae to shallow areas along the open coast where they settle. These transforming stages are still capable of pelagic swimming activity and continue to recruit to the estuary, typically swimming deeper in the water column than the early stages. Estuarine factors, particularly bottom salinity at the end of ebb tide, are most strongly correlated with recruitment of these stages. It seems that tidal-stream transport is the primary mechanism used by English sole to recruit to the estuary, but the mechanism of locating the estuary and timing of entry is relatively complex. (Author's abstract)

BEHAVIOUR OF URANIUM ISOTOPES WITH SALINITY CHANGE IN THREE U.K. ESTUARIES,

Glasgow Univ. (Scotland). Dept. of Chemistry. For primary bibliographic entry see Field 2K. W88-08720

FRESHWATER PHYTOPLANKTON IN THE LOW SALINITY REGION OF THE RIVER TAMAR ESTUARY, Southampton Univ. (England). Dept. of Oceanog-

rapny. R. H. Jackson, P. J. B. Williams, and I. R. Joint. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 3, p 299-311, September 1987. 6 fig, 24 ref.

Descriptors: "Aquatic plants, "Plankton, "Tamar River, "Phytoplankton, "Algae, "Salinity, "Saline-freshwater interfaces, "Estuaries, "Rivers, "Oxygen depletion, "Turbidity, United Kingdom, Mortality, Degradation, Decomposition, Bacteria, Chlorophyll, Photosynthesis, Biomass, Dissolved oxygen, Hydrogen ion concentration, Water temperature, Tides, River flow, Light penetration, Diatoms, Cyclotella, Aquatic environment.

An investigation was made into the fate of freshwater algae in the Tamar estuary, south-west England, to examine the hypothesis that oxygen minima, observed at the freshwater-brackish water interface, were a consequence of mass mortality of freshwater algae and the subsequent oxidative degradation of the lysed cells by bacteria. The quantity and species composition of algae in the river and estuary were determined by measurements of chlorophyll and cell numbers. Phytoplankton numbers were transformed into biomass by measuring the volume of the cells and calculating the carbon content. Salinity, dissolved oxygen, turbidity, pH, and temperature were also recorded. The size of the upper estuarine community was inversely related to freshwater input. During the summer months, very large populations of freshwater algae (up to 8 mg carbon per liter) were observed between 0 and 8 parts per thousand salinity, after long periods of low freshwater input. This population was completely dominated by the diatom Cyclotella atomus and was very stable with respect to changing tides, remaining in the estuary until river flow increased. Death of these algae only occurred at salimities greater than 8 parts per thousand and oxygen minima were not observed. The oxygen

minima were more closely associated with the turbidity maxima than with algal mortality. There is some evidence that the oxygen depletion may be due to decreased photosynthesis as a result of the reduced light availability at the turbidity maxima. (Author's abstract) W88-08721

SEASONAL DIFFERENCES IN SPARTINA RE-COVERABLE UNDERGROUND RESERVES IN THE GREAT SIPPEWISSETT MARSH IN MAS-SACHUSETTS,

Delaware Univ., Newark. Coll. of Marine Studies. For primary bibliographic entry see Field 21. W88-08722

TEMPORAL VARIATIONS OF SECONDARY PRODUCTION IN THE MARINE BIVALVE SPISULA SUBTRUNCATA OFF THE PORIVER DELTA (ITALY),

Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. For primary bibliographic entry see Field 2H. W88-08726

REJUVENATED MARSH AND BAY-BOTTOM ACCRETION ON THE RAPIDLY SUBSIDING COASTAL PLAIN OF U.S. GULF COAST: A SECOND-ORDER EFFECT OF THE EMERGING ATCHAFALAYA DELTA,

Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments. For primary bibliographic entry see Field 2J. W88-0872.

PU-239,240 IN ESTUARINE AND SHELF WATERS OF THE NORTH-EASTERN UNITED STATES.

Woods Hole Oceanographic Institution, MA. E. R. Sholkovitz, and D. R. Mann. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 4, p 413-434, October 1987. 12 fig, 1 tab, 38 ref. NSF Grants OCE-8300742 and OCE-95111300

Descriptors: *Water circulation, *Radioisotopes, *Plutonium, *Estuaries, *Continental shelf, Particulate matter, Solutes, Salinity, Bottom water, Anaerobic conditions, Coagulation, Spatial distribution, Flushing, Coastal waters, United States, Connecticut River, Delaware Bay, Chesapeake Bay, Tracers.

The distribution of plutonium-239,240 between dissolved and particulate forms has been measured in four estuaries on the northeast coast of the United States (Connecticut River, Delaware Bay, Chesapeake Bay, and Mullica River). The data cover the whole salinity range from freshwater input to shelf waters at 39 parts per thousand and includes one profile from a nearly anoxic basin in the Chesapeake Bay. In the organic-rich Mullica River estuary, large-scale removal of riverine dissolved Pu-239,240 occurs at low salinities due to salt-induced coagulation, a mechanism analogous to that for iron and humic acids. Within the 0 to 25-30 parts per thousand zone in the other three estuaries, the activity of dissolved Pu-239,240 increases almost conservatively. The activities of particulate Pu-239,240 are highest in the more turbid waters of low salinity regime (0-15 parts per thousand), but become increasingly insignificant with respect to dissolved Pu-239,240 as salinities increase. At higher salinities corresponding to shelf water, there is a sharp increase in dissolved Pu-239,240 activity. The dissolved Pu-239,240 activities than does the Connecticut River estuary which has a flushing time of the water. For example, Chesapeake Bay has a 6-12 month flushing time and has much lower dissolved Pu-239,240 activities than does the Connecticut River estuary which has a flushing time of a few days. This and other data from the shelf waters are interpreted as indicating that the sharp decrease in dissolved Pu-239,240 activities between shelf and estuarine waters is driven by removal within the estuaries themselves rather than on the shelf. Dissolved Pu-239,240 activities removal within the estuaries themselves rather than on the shelf. Dissolved Pu-239,240 activities rate of the mean than on the shelf. Dissolved Pu-239,240 activities are lower in the nearly-anoxic bottom waters of

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Chesapeake Bay indicating enhanced removal by redox transformation of Pu-i.e., Pu(V) to Pu(IV). (Author's abstract) W88-05728

EFFECTS OF MICRO-SCALE IN SITU ENVI-RONMENTAL GRADIENTS CONCERNING WATER QUALITIES ON THE STRUCTURE OF THE PHYTOPLANKTON IN A COASTAL EM-BAYMENT, Hiroshima Univ. (Japan). Inst. of Environmental

For primary bibliographic entry see Field 5C. W88-08729

TEMPORAL SAMPLING AND DISCHARGE ASYMMETRY IN SALT MARSH CREEKS, Manchester Univ. (England). Dent. of Geography. ster Univ. (England). Dept. of Geography.

D. J. Reed. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 4, p 459-456, October 1987. 3 fig, 2

Descriptors: *Estuaries, *Tidal rivers, *Wetlands, *Salt marshes, *Tidal marshes, *Streamflow, *Stream discharge, *Sampling, *Discharge measurement, Flow characteristics, Flow velocity, Tides, Temporal distribution, Errors, United King-

Studies of tidal flows in salt-marsh creeks have shown velocity pulses on certain tides, although these have often been overlooked in considering temporal sampling designs for the measurement of discharge asymmetry. Velocity measurements for both spring and neap tides were taken at 5-min intervals at Bridge Creek in southeast Essex. The importance of temporal sampling interval in determortance of temporal sampling interval in determiervais at Bruge Creek in Southeast Essex. The importance of temporal sampling interval in deter-mining measured discharge asymmetry is examined using these data, integrating at intervals of between 5 and 30 min. The results indicate that sampling at 30-min intervals can underestimate discharge when velocity nulses on string tides are not accurately. velocity pulses on spring tides are not accurately monitored. Both under- and over-estimation of dis-charge on neap tides suggests that temporal sampling is also an important consideration when ve-locity pulses do not occur. (Author's abstract) W88-08730

SUSPENDED SEDIMENT FLUCTUATIONS IN THE TAGUS ESTUARY ON SEMI-DIURNAL AND FORTNIGHTLY TIME SCALES,

Instituto Nacional de Investigação des Pescas,

Lisbon (Portugal).
C. Vale, and B. Sundby.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 25, No. 5, p 495-508, November 1987. 8 fig. 22

Descriptors: *Sediments, *Suspended sediments, *Estuaries, *Tagus Estuary, Data collections, On-site data collections, Fluctuations, Temporal distri-bution, Portugal, Tides, Water currents, Stream discharge, Turbidity, Bays, Salinity, Vertical distri-bution, Neap tides, Spring tides, Erosion, Sedimen-tation, Bettom currents tation. Bottom currents.

Nine multi-ship synoptic surveys of the distribution of suspended sediment, each survey including the distribution at both low and high tide, were carried out over a 12-month period in the mesotidal Tagus estuary in Portugal. Additional measurements of the semi-diurnal fluctuations of suspended sedi-ment concentration and current strength were made at fixed stations during a neap and a spring tide. During the study period, the river discharge of water and suspended sediment remained below the mean annual discharge and did not show a pronounced seasonal fluctuation. A turbidity maxipronounced seasonal fluctuation. A turbidity maximum, defined as an area with suspended sediment concentrations greater than 50 mg/l, was absent during neap tides (1.3-m amplitude), but appeared and grew in both extent and turbidity as the tidal amplitude increased. The turbidity maximum was fully developed during spring tides (>3-m amplitude) with concentrations greater than 50 mg/l throughout the entire estuary. Maximum concentrations, reaching as much as 1000 mg/l during spring tides, were always found in the inner shallow bay region of the estuary. In contrast to the

salinity distribution, which fluctuated between partly stratified during neap tides and well mixed during spring tides, the vertical distribution of suspended matter in the turbidity maximum zone was always stratified with the highest concentrations near the bottom. The semi-diurnal fluctuation tions near the ootom. In esemi-durinal incutation of the suspended sediment concentration was negligible during neap tides, but attained magnitudes during spring tides that were comparable to the fortnightly fluctuation. The fluctuation in suspendfortnightly fluctuation. The fluctuation in suspend-ed matter concentration is interpreted as a fort-nightly erosion-sedimentation cycle, caused by a cyclic variation in the strength of the bottom cur-rents. Superimposed on this fortnightly cycle is a semi-diurnal cycle. The amount of material in-volved in these cycles is equivalent to one year's input of suspended sediment by the Tagus river during normal discharge conditions. (Author's ab-stract) W88-08732

TURBULENT PERTURBATIONS OF VELOCITY IN THE CONWY ESTUARY, Birmingham Univ. (England). Dept. of Civil Engi-

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 5, p 533-553, November 1987. 10 fig, 3

Descriptors: *Unsteady flow, *Estuaries, *Water circulation, *Tidal currents, *Turbulent flow, *Flow velocity, Variability, Density stratification, Tides, Tidal effects, On-site investigations, Fluid flow, Mixing, Shear, Shear stress, Conwy Estuary, United Kingdom, Flow measurement.

Field measurements of the vertical and horizontal reto measurements of the vertical and horizontal components of fluid velocity 0.43 m above the bed have been made with an electromagnetic flowmeter in a partially-mixed reach of the Conwy estuary for parts of a flood and an ebb tide. The turbulent for parts of a flood and an ebb tide. The turbulent mean velocity and density fields showed different effects for flood and ebb tides caused by the interaction of shear and longitudinal density gradient. The turbulent velocity parameters were generally dominated by bed-generated turbulence effects, but significant longer-period contributions attributed to the shear-density interactions were detected. The shear-stress measurements made by two independent each of the shear-stress measurements made by two independent each of the shear-stress measurements made by two independent each of the shear-stress measurements made by two independent each of the shear-stress measurements made by two independent each of the shear-stress measurements made by two independent each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements made by two independents each of the shear-stress measurements are shear the shear-stress measurements and the shear-stress measurements are shear the shear-stress measurements and the shear-stress measurements are shear the shear-stress measurements and the shear-stress measurements are shear the shear the shear-stress measurements are shear the shear t pendent methods showed good agreement. The results generally show good agreement with previous less complete data. The use of the Richardson number to quantify vertical stability needs further (Author's abstract)
W88-08734

SEASONAL CYCLE OF THE CILIATED PROTOZOAN AND MICROMETAZOAN BIOMASS IN A GULF OF MAINE ESTUARY,

IN A GULF OF MAINE ESTUARY, Maine Univ., Orono. Dept. of Zoology. N. Revelante, and M. Gilmartin. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 5, p 581-598, November 1987. 8 fig, 2 tab, 67 ref. NSF Grant PPM 8011448.

Descriptors: *Estuaries, *Aquatic animals, *Plank-Descriptors: Testuaries, "Aquatic animats, "Flank-ton, "Zooplankton, "Protozoa, "Biomass, Seasonal distribution, Population dynamics, Primary pro-ductivity, Phytoplankton, Gulf of Maine, Fish food organisms, Predation.

The annual cycle of microzooplankton and their potential prey were followed in an estuary typical of the drowned river valleys of the Gulf of Maine. Changes in dominant components and size-class structure indicated an annual cycle forming a predator-prey link to the spring phytoplankton bloom, increasing in size-class structure to a maximum in early summer, implying a prey-predator link to larval fish populations. During most of the year the non-tintinnid ciliates dominated in both abundance and biomass, with tintinnids and micrometazoans only being important during a three-month period and biomass, with tintinnids and micrometazoans only being important during a three-month period in late summer. The non-tintinnid ciliate seasonal cycle was more closely coupled with the nanoplankton prey crop compared with other components, indicating similar biological characteristics. Increases in the biomass of the phytoplankton prey crop occurred towards the head of the estuary,

evenly across the size spectrum. In contrast, con-current increases in the microzooplankton were biased towards the larger size classes into the estu-ary. The distribution of the phototrophic ciliate Mesodinium rubrum suggests it may be a potential-ly important primary producer in the estuary. (Au-'s abstract) W88-08737

SOURCES AND TRANSPORT OF PARTICU-LATE ORGANIC CARBON IN THE AMAZON RIVER AND ESTUARY,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
D.-L. Cai, F. C. Tan, and J. M. Edmond.
Estuarine; Coastal and Shelf Science ECSSD3, Vol. 26, No. 1, p 1-14, January 1988. 9 fig. 2 tab, 25

Descriptors: *Particulate matter, *Organic Carbon, *Rivers, *Estuaries, South America, Amazon River, Tributaries, Marine environment, Plumes, Isotope studies, Industrial wastes, Plankton.

Stable carbon isotope ratios were used to study the sources of particulate organic carbon (POC) in the Amazon River and its tributaries as well as to examine the transport of the riverine POC into the examine the transport of the riverine POC into the oceanic environment. POC in the upper reaches of the Amazon River has more positive delta-13-carbon values (24.5 to -28.0 parts per thousand) than that in the middle and lower reaches (27.9 to -30.1 parts per thousand). The delta-13-C content of POC from the tributaries is generally more negative than that observed in the Amazon main channel. This delta-13-C evidence shows that the POC in the Amazon main channel is predominant. POC in the Amazon main channel is predominantly of terrestrial origin rather than a result of in situ production. Organic carbon form three sources may contribute to the total POC in the main channel and tributaries: (1) terrestrial organic carbon of net and trioutaries: (1) terrestrial organic carbon of natural origin, (2) terrestrial organic carbon of man-made (domestic and industrial wastes) origin, and (3) living or dead organic matter of planktonic origin produced within the main channel and tribuorigin produce within the main channel and tributaries. A large range of delta-13-C values (-17.5 to - 28.4 parts per thousand) is observed in the Amazon estuary and plume and is attributed to the mixing of riverine and marine POC. POC delta-13-C measurements detect riverine organic detritus as far as 290 km offshore in a direction parallel to the river channel; the isotopic signal of riverine POC can be seen as far as 1100 km to the north-west of the river mouth in the Amazon River plume. (Author's abstract) W88-08738

VERTICAL TURBULENT MIXING PROCESS-ES ON EBB TIDES IN PARTIALLY MIXED

Birmingham Univ. (England). Dept. of Civil Engi-

J. R. West, and K. Shiono. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 1, p 51-66, January 1988. 10 fig, 15 ref.

Descriptors: *Estuaries, *Water currents, *Tides, *Tidal currents, *Mixing, *Turbulent flow, *Vertical flow, Flow profiles, Flow velocity, Salinity, Reynolds Number.

Measurements of turbulent fluctuations of the hori-Measurements of turbulent fluctuations of the horizontal and vertical components of velocity and of salinity in the region 1-1.25 m above the bed were made in the Teign estuary in southern England during parts of three ebb tides of different tidal ranges. The turbulent mean flow field determined from vertical profiles of velocity and salinity varied from well mixed to partially mixed depending on the relative importance of the vertical gradient and of the mixing effect of bed-senerated turent and of the mixing effect of bed-generated tur-bulence. The turbulence parameters showed regu-lar temporal trends. The relative intensity values lar temporal trends. The relative intensity values for the new and existing data for the velocity components are strongly dependent on relative depth but not generally affected by Richardson number. The horizontal Reynolds flux correlation coefficient increased with Richardson number. These effects are tentatively explained by the con-cept of turbulent fluctuations being replaced by wavelike fluctuations in stable conditions. Results for momentum and solute mixing lengths help to substantiate previously published values. (Author's abstract) W88-08739

SEDIMENT DYNAMICS AND DEPOSITION IN A RETREATING COASTAL SALT MARSH, Manchester Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 2J. W88-08740

SECONDARY PRODUCTION OF BENTHIC MOLLUSCS FROM THE DELAWARE BAY AND COASTAL AREA, California State Univ., Long Beach. Dept. of Biol-

S. Howe, D. Maurer, and W. Leathem. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 1, p 81-94, January 1988. 3 fig. 2 tab, 49 ref. National Marine Fisheries Service Contract NA-80-FA-C-00032.

Descriptors: *Estuaries, *Coastal waters, *Benthic fauna, *Mollusks, *Secondary productivity, Biomass, Clams, Mytilus, Sand, Annual distribution, Seasonal distribution, Delaware Bay, Atlantic

Ocean.

Secondary production of benthic mollusks was estimated for one Delaware Bay site and two coastal Delaware sites for 1980 and 1981. Direct measurements of production, mean biomass, and turnover ratios were ranked for six select species: Ensis directus, Mytilus edulis, Nucula annulata, Nucula proxima, Spisula solidissima, and Tellina agilis. Indirect measurements of remaining mollusk species accounted for a range of 26.2-59.0% of total mollusk production. Total mollusk production was highest at the Delaware Bay station (21,775.0 milligrams ash-free dry weight—AFDW-per square meter per year), slightly lower at the coastal station nearest the Bay mouth (19,20.3 mg AFDW per square m per year), and markedly lower at the coastal station furthest from the Bay mouth (1571.0 mg AFDW/square m/year). This pattern also reflected an association with sediment type as production was higher in fine sand than in coarse sand. Peak production varied seasonally and there was considerable annual variability at two stations. It was concluded that estimates of secondary production and tereat was entire the seasons. It was concluded that estimates of secondary pro-duction and turnover ratios of dominant Delaware Bay area molluscs were similar to estimates for the same species or related species from other similar habitats. (Author's abstract) W88-08741

DISTRIBUTION OF MOLLUSCS AND POLY-CHAETES IN COASTAL LAGOONS IN

Athens Univ. (Greece). Zoological Lab. and Museum.

Nuscum.

A. Nicolaidou, F. Bourgoutzani, A. Zenetos, O. Guelorget, and J.-P. Perthuisot.

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 4, p 337-350, April 1988. 11 fig. 3 tab,

Descriptors: *Estuaries, *Coastal waters, *Lagoons, *Estuarine environment, *Baseline studies, *Aquatic animals, *Annelids, *Polychaetes, *Mollusks, Distribution patterns, Ecological distribution, Animal populations, Salinity, Dissolved oxygen, Bottom water, Sedimentology, Greece.

Hydrochemical (salinity, dissolved oxygen) and se-Hydrochemical (salinity, dissolved oxygen) and se-dimentological parameters were investigated in the Messologhi lagoonal area of Greece in July 1981 and compared to the distribution of mollusks and polychaetes by means of the Spearman rank corre-lation. Dissolved oxygen in bottom waters showed the most obtions correlation with the distribution iation. Dissolved oxygen in bottom waters showed the most obvious correlation with the distribution of species. The grouping of sampling stations based upon their faunal affinities displays a zonal organi-zation of lagoonal populations which may be ac-counted for in terms of extent of isolation from the open sea, as in other Mediterranean lagoonal sys-tems. Hydrological parameters may account better for the biological organization of lagoons than hydrochemical or sedimentological factors because

they control the rate of exchanges with the open sea in each locality. (Shidler-PTT) W88-08743

LATERAL DENSITY DISTRIBUTION IN A PARTIALLY MIXED ESTUARY, William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.

L. M. Huzzey. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 4, p 351-358, April 1988. 4 fig, 13 ref.

Descriptors: *Estuaries, *Density, *Mixing, Water circulation, Water currents, Tidal currents, Tides, Water depth, Spatial distribution, Virginia, Chesapeake Bay, York River.

The density distribution across the York River in Virginia is characterized by distinct inhomogeneities, especially in the upper 2 m of the water column. The pattern of variability is repetitive and closely correlated with the semi-diurnal tidal cycle and water depth. In the shallow areas the water column remains vertically well-mixed at all times. The density differences are greatest at times of minimum currents. At slack-before-flood, the least dense water is located in a lens over the main minimum currents. At slack-before-flood, the least dense water is located in a lens over the main channel. Towards the end of the flood cycle, and at slack-before-ebb, this is reversed with the least dense water situated over the shoals. These density differences result in horizontal pressure gradients which at times may be of sufficient strength to generate localized lateral circulations. Such circulation patterns would form zones of convergence or divergence across the estuary depending on the particular density distribution. (Author's abstract) W88-08744

CCRETION RATES IN SALT MARSHES IN HE EASTERN SCHELDT, SOUTH-WEST

NETHERLANDS, Louisiana Water Resources Research Inst., Baton For primary bibliographic entry see Field 2J. W88-08745

ABUNDANCE OF YOUNG BROWN SHRIMP IN NATURAL AND SEMI-IMPOUNDED MARSH NURSERY AREAS: RELATION TO TEMPERATURE AND SALINITY, Louisiana Agricultural Experiment Station, Baton

Nouge. W. H. Herke, M. W. Wengert, and M. E. LaGory. Northeast Gulf Science NGSCDE, Vol. 9, No.1, p 9-23, April 1987. 3 fig, 4 tab, 56 ref.

Descriptors: "Estuarine environment, "Environmental effects, "Marshes, "Wetlands, "Shrimp, "Water temperature, "Salinity, Brown shrimp, Marsh Island, Louisiana, Salt marshes, Juvenile growth stage, Aquatic habitats, Habitats, Population dynamics, Growth, Weirs, Aquatic animals.

Samples of brown shrimp (Penaeus aztecus, 10 to 130 mm in total length) were collected with otter trawls weekly from 14 March to 20 August 1971 in brackish marsh areas at Marsh Island, Louisiana. Catches were largest from 1 May to 4 June in the natural marsh and from 1 May to 4 June in the natural marsh and from 1 May to 4 July in the semi-impounded marsh (influenced by weirs). Total catch was four times greater in the natural than in the semi-impounded areas, and emigrated at a larger size. Water temperatures above 20 C were apparently more conducive to the growth of young brown shrimp than was a particular salinity range. The range of recorded salinities was 0.57-12.85 parts per thousand; catch per sample was highest in salinities from 2.0 to 2.99 parts per thousand. (Author's abstract)

FISH FAUNA OF LAKE MAUREPAS, AN OLI-GOHALINE PART OF THE LAKE PONT-CHARTRAIN ESTUARY, Southeastern Louisiana Univ., Hammond. Dept. of

Northeast Gulf Science NGSCDE, Vol. 9, No. 2, p 89-98, December 1987. 1 fig. 6 tab, 15 ref.

NOAA Grant NA-83-AAA-D-CZ025.

Descriptors: *Lakes, *Estuaries, *Fish populations, Saline lakes, Lake Pontchartrain, Lake Maurepas, Louisiana, Aquatic habitats, Habitats, Population dynamics, Aquatic animals.

Lake Maurepas is a slightly saline body of water located at the upper end of the Lake Pontchartrain estuary. Of 67 fish species collected during 1983-84, 33 species (49%) were primarily fireshwater, 6 (9%) were primarily marine, and 28 (42%) were estuarine or diadromous. Major freshwater species (blue catfish, channel catfish, and freshwater drum) were present throughout the year, whereas most were present throughout the year, whereas most marine and estuarine species were seasonally present (bay anchovy, gulf menhaden, and Atlantic croaker) or were present during periods of higher (up to 2.5 part per thousand) salinity (sand sea-trout, spot, black drum). Bay anchovy dominate the catch numerically (70% of the total). Ten the caich numerically (70% of the total). Ten predominant species accounted for 97.2% of the total catch. A total of 74,202 individuals were collected. In addition to the species discussed above, fish species represented by 10 or more individuals included spotted gar, longnose gar, alligator gar, American eel, speckled worm eel, skirpjack herring, gizzard shad, threadfin shad, pixele perch, gulf killifish, mosquitofish, least killifish, mland silverside, gulf pipefish, yellow bass, striped bass, bluegill, longear sunfish, redear sunfish, striped mullet, naked goby, and hogchoker. (Cassar-PTT) sar-PTT) W88-08751

SOURCES OF NITROGEN AND PHOSPHORUS IN AN ESTUARY OF THE CHESAPEAKE

Agricultural Research Service, Beltsville, MD. Environmental Chemistry Lab. For primary bibliographic entry see Field 5B. W88-08753

MACRONUTRIENT CONTROLS ON NITRO-GEN FIXATION IN PLANKTONIC CYANO-BACTERIAL POPULATIONS,

California Univ., Berkeley. Dept. of Civil Engineering.

For primary bibliographic entry see Field 2H. W88-08769

PATTERNS OF DARK 14CO2 INCORPORA-TION BY NATURAL MARINE PHYTOPLANK-TON COMMUNITIES,

Democritos Nuclear Research Center, Athens

L. Ignatiades, M. Karydis, and K. Pagou. Microbial Ecology MCBEBU, Vol. 13, No. 3, p 249-259, 1987. 5 fig, 2 tab, 37 ref.

Descriptors: *Carbon dioxide, *Phytoplankton, *Eutrophication, *Carbon radioisotopes, *Micro-biological studies, In situ tests, Oligotrophy, Eutrophic waters, Oligitrophic waters, Autocorrelation

The rates of dark 14CO2 fixation by natural phyto-plankton communities growing in eutrophic and oligotrophic waters were studied with short-term oligotrophic waters were studied with short-term in situ experiments. Three aspects were investigated: (1) the time course incorporation of 14CO2 in darkness, (2) the depth variability in dark 14CO2 instation, and (3) the variability in 14CO2 fixation within a year. The highest dark 14CO2 incorporation rates were observed during the first interval of incubation (20 min) after which they approached a constant rate with time. The observed differences in dark 14CO2 fixation rates between populations from different depths were associated with differences in species composition as well as with physicological differences caused by exposure to different illumination conditions prior to their exposure to darkness. Autocorrelation coefficients were comdarkness. Autocorrelation coefficients were com-puted for the analysis of variability of dark 14CO2 fixation rates within a year. It was suggested that dark 14CO2 incorporation might be a periodic phenomenon depending mainly on the productive capacity of the phytoplankton community. (Au-thor's abstract) thor's abstract)

Group 2L—Estuaries

W88-08790

DISTRIBUTION OF ULTRAMICROBACTERIA IN A GULF COAST ESTUARY AND INDUC-TION OF ULTRAMICROBACTERIA, University of West Florida, Pensacola. Dept. of

University of west Farman States and States

Descriptors: *Estuaries, *Bacteria, *Microbiological studies, *Alabama, Gulf Coast, Pseudomonas, Vibrio, Ultramicrobacteria.

pass through a 0.2 micron filter) in a subtropical Alabama estuary was determined in a subtropical The abundance of ultramicrobacteria (bacteria that pass irrough a 0.2 micron mery in a sourtopical Alabama estuary was determined during a 1-year period. Although phenotypic and molecular char-acterization indicated that the population of ultra-microbacteria was dominated by Vibrio species, microbacteria was dominated by Vibrio species, species of Listonella nd Pseudomonas were also abundant. Vibrios occurred with the greatest frequency in waters whose salinities were less than 14 parts per thousand, and were the most abundant species of the total ultramicrobacterial population year-round, while Pseudomonas species were absent or considerably reduced during the winter months. The total number of ultramicrobacteria showed an inverse relationship to total heterotrophic bacteria s measured by colony-forming units (CFU)/ml and to water quality as measured by showed an inverse relationism to total neteriorisphic bacteria s measured by colony-forming units (CFU)/ml and to water quality as measured by several parameters. Analysis by generic composition indicated that both salinity and temperature significantly affected the distribution of these organisms. Laboratory studies revealed that strains of nisms. Laboratory studies revealed that strains of vibrios under starvation in both static and continuous-flow microcosms could be induced to form cells that passed through 0.2 and/or 0.4 micron filters. Cells exposed to low nutrients became very small; some grew on both oligotrophic (5.5 mg Carbon/liter) and eutrophic (5.5 g Carbon/liter) media; and some few cells grew only on oligotrophic media. By passing selected Vibrio strains on progressively diluted nutrient media, cells were also obtained that were small, that passed through 0.4 micrometer filters, and that could grow in oligotrophic media. These results suggest that ultramicrobacteria in estuaries may be nutrienttramicrobacteria in estuaries may be nutrient-starved or low nutrient-induced forms of certain heterotrophic, eutrophic, autochthonous, estuarine bacteria. (Author's abstract) W88-08795

ANAEROBIC MICROBIAL METHYLATION OF INORGANIC TIN IN ESTUARINE SEDI-

MENT SLURRIES,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 5B.
W88-08798

STUDY OF THE OCCURRENCE AND DISTRI-BUTION OF BDELLOVIBRIOS IN ESTUA-RINE SEDIMENT OVER AN ANNUAL CYCLE, Maryland Univ., Baltimore. Dental School.

Microbial Ecology MCBEBU, Vol. 15, No. 1, p 9-20, 1988. 2 fig, 3 tab, 16 ref. NSF Grant R11-8411310.

Descriptors: *Vibrio, *Estuarine environments, *Sediments, *Bacteria, *Seasonal variation, *Microbiological studies, Annual distribution.

The recovery of bdellovibrios from estuarine sediments over an annual cycle was studied. Greater numbers of the predators were received in sediment than in the water column. Increases in the number of bdellovibrios recovered from sediment over various periods of time suggest that multipli-cation of the predators occurred. Sediment was observed to be an important ecosystem for the survival of the bdellovibrios in the winter months. As has been observed in water, the number of bdellovibrios in sediment fluctuated, with seasonal and temperature changes declining to very low numbers during the winter months. In the colder months, low numbers of the predators appeared to winter-over in sediment, with greater numbers of

the organisms being recovered from deeper sedi-ment. As the water temperature warmed in the spring, increases in the number of bellovibrios occurred first in the sediment and subsequently in the water. This increase of bdellovibrios in sedithe water. This increase of bdellovibrios in sediment may have resulted in the shedding of the organisms into the water column where their numbers subsequently increased. Population fluctuations of bdellovibrios were similar in both water and sediment. Although the temperature may account for much of the observed fluctuation in the number of bdellovibrios, other factors, including salinity and the number of host bacteria, may also play a major role. The number of bdellovibrios recovered from sediment correlated positively with the water temperature, and negatively with the water salinity and the number of bacterial colony-forming units from sediment. The results of this study revealed the significance of sediment to the seasonal cycle, survival, and growth of the bdellovibrios in an estuarine environment. (Author's abstract) thor's abstract) W88-08800

BACTERIAL PRODUCTIVITY AND MICROBI-AL BIOMASS IN TROPICAL MANGROVE

Australian Inst. of Marine Sciences, Townsville. D. M. Alongi. Microbial Ecology MCBEBU, Vol. 15, No. 1, p 59-79, 1987. 5 fig. 3 tab, 53 ref.

Descriptors: *Biomass, *Bacteria, *Australia, *Wetlands, *Tropical regions, *Mangrove swamps, *Microbiological studies, *Estuaries, *Productivity, Algal biomass, Microbial biomass, Aquatic productivity.

Bacterial productivity (3H-thymidine incorporation into DNA) and intertidal microbenthic communities were examined within five mangrove estuaries along the tropical northeastern coast of
Australia. Bacteria in mangrove surface sediments
(0-2 cm depth) were enumerated by epifluorescence microscopy and were more abundant (mean
and range: 1.00.02-3.6) times 10 to the 11th power
cells-g/DW) and productive (mean: 1.6 gC/sq m
d) compared to bacterial populations in most other
benthic environments. Specific growth rates (mean
= 1.1) ranged from 0.2-5.5 per d with highest rates
of growth in austral spring and summer. Highest
bacterial numbers occurred in winter (JuneAugust) in estuaries along the Cape York peninsula
north of Hinchin brook Island and were significantly different among intertidal zones and estucantly different among intertidal zones and estu-aries. Protozoal (100,000-1,000,000 per sq m), pheopigments (0.0-24.1 microg per g DW) and bacterial productivity (0.2-5.1 gC/sq m/d) exhibitbacterial productivity (0.2-3.1 gC/sq m/o) exhibited significant seasonality with maximum densities and production in austral spring and summer. Algal biomass (chlorophyll a) was low (mean:1.6 microg per g DW) compared to other intertidal sediments because of low light intensity under the dense forest canopy, especially in the mid-intertidal zone. Partial correlation analysis and a study of zone. Partial correlation analysis and a study of possible tidal effects suggest that microbial biomass and bacterial growth in tropical intertidal sediments are regulated primarily by physiochemical factors and by tidal flushing and exposure. High microbial biomass and very high rates of bacterial productivity coupled with low densities of meiofaunal and macroinfaunal consumers observed in earlier studies suggest that microbes may be a sink for carbon in intertidal sediments of tropical mangrove estuaries. (Author's abstract) W88-08802

DYNAMICS OF ORGANIC MATERIALS IN THE CAMPBELL RIVER ESTUARY AT THE TIME OF THE SPRING BLOOM OF PHYTO-

PLANKTON, Tsukuba Univ. (Japan). Inst. of Biological Sci-

H. Seki, A. Otsuki, Y. Hara, K. V. Stephens, and C. D. Levings.

Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 209-216, December 1987. 3 tab, 16 ref.

Descriptors: *Estuaries, *Campbell River Estuary, *Phytoplankton, *Mesotrophy, *Salmon, *Fish, Dynamics, Bacterial analysis, Kinetics, Flushing, Organic matter, Juvenile growth stage.

The microbial contribution to the maintenance of The microbial contribution to the maintenance of desirable environments for juvenile salmon was studied at the Campbell River Estuary during the 1984 spring bloom of phytoplankters. The turnover rate of dissolved organic materials was much lower than in the preceding summer (1983). The phytoplankton density in the estuary and its adjacent area was moderately high and within the mesotrophic range. Due to high spring river discharge, heterogeneity in bacterial kinetics parameters was less than observed in summer of 1983. The shorter residence of water in the upper brackish layer in the spring reduces the time available for the development of trophic heterogeneity. (See also W88-08818) (Author's abstract)

MICROBIAL KINETICS AND PHYTOPLANK-TON IN SALMONID HABITATS OF THE CAMPBELL RIVER ESTUARY IN AUTUMN, Tsukuba Univ. (Japan). Inst. of Biological Sci-

H. Seki, A. Otsuki, Y. Hara, and C. D. McAllister. Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 217-224, December 1987. 3 tab, 16 ref.

Descriptors: *Phytoplankton, *Salmon, *Campbell River Estuary, *Estuaries, *Litter, *Decomposition, *Detritus, *Organic matter, Dynamics, Kinetics, Microbiological studies.

The microbial contribution to the dynamics of organic materials in the Campbell River Estuary was studied in 1985 during the autumn bloom of phytoplankters. The phytoplankton densities in the estuary and its adjacent area were lower during this autumn bloom than those during the spring bloom of phytoplankton in 1984, but microbial activity was greater. This is attributed to higher rates of organic inputs from decaying marsh detritus, leaf litter and salmon carcasses. (See also W88-08817) (Author's abstract) The microbial contribution to the dynamics of

TWO-DIMENSIONAL SHALLOW WATER FLOW IDENTIFICATION, Rijkswaterstaat, The Hague (Netherlands). Data Processing Div. A. W. Heemink. Applied Mathematical Modeling AMMODL, Vol. 12, No. 2, p 109-118, April 1988. 6 fig, 26 ref.

Descriptors: *Shallow water, *Hydrodynamics, *Model studies, *Mathematical studies, *Coastal waters, *Storm surges, *Flow, *Finite element method, Stochastic process, Spatial distribution, Prediction, Water level, Equations.

A discrete time-invariant Kalman filter for the identification and prediction of two-dimensional shallow water flow using observations of the water level registered at some locations, has been developed. The filter is based on a set of difference equations derived from the linear two-dimensional shallow water equations using the finite difference scheme proposed by Sielecki. By introducing a system noise process, we can embed the difference equations into a stochastic environment. This enables us to take into account the uncertainties of these equations. A Chandrasekhar-type algorithm is employed to obtain the steady-state filter. In this way the fact that the noise is less spatially variable than the underlying process can be exploited to reduce the computational burden. The capabilities of the filter are illustrated by applying it to the sixhours-ahead prediction of storm surges in the North Sea. The results show excellent filter performance, and, with respect to the results of the A discrete time-invariant Kalman filter for the NOTIFICATION SEA. THE rESULTS SHOW excellent filter performance, and, with respect to the results of the underlying deterministic model which were achieved without using the water-level measurements available, the improvement obtained by filtering the measurements is substantial. (Author's abstract) W88-08847

CONTAMINATED SEDIMENTS IN THE ELBE ESTUARY: ECOLOGICAL AND ECONOMIC PROBLEMS FOR THE PORT OF HAMBURG, Behoerde fuer Wirtschaft, Verkehr und Landwirts

Estuaries—Group 2L

chaft, Hamburg (Germany, F.R.). For primary bibliographic entry see Field 5E. W88-08866

OLIGOCHAETE RESPIRATION AS A MEASURE OF SEDIMENT TOXICITY IN PUGET SOUND, WASHINGTON, bibliographic entry see Field 5A.

DISTRIBUTION AND BIOMASS OF THE SEA-GRASS ZOSTERA CAPENSIS IN A WARM-TEMPERATE ESTUARY, Port Elizabeth Univ. (South Africa). Dept. of

Botanica Marina BOTNA7, Vol. 30, No. 1, p 91-99, January 1987. 5 fig, 45 ref.

Descriptors: *Plant populations, *Estuarine envi-ronment, *Sea grasses, *Seasonal variation, Zos-tera, Ecology, Epiphytes, South Africa, Biomass.

A winter (June 1981) and summer (December 1981) survey of the seagrass Zostera capensis was carried out in the well-developed warm-temperate Swartkops estuary, South Africa. The area covered by Z. capensis increased from 13.7 ha (3% of the estuary) in winter to 16.1 ha in December. With few exceptions, this increase was due to the extension of existing beds rather than the appearance of new beds. More than 90% of the beds were within 6 km of the mouth, and more than half in one of the arms of the estuary (Tipper's Creek). Epiphytes contributed 28% of the total biomass in summer. Subsequent surveys of the estuary in 1984 and 1986, together with historical aerial photographs, have implicated a complex pattern of population dynamics. Variations in population size included flood- or season-related fluctuations and complete, but temporary disappearance of the population in response to catastrophic events. A similar disappearance is recorded for the small population of Z. capensis in the adjacent Sundays estuary. (Author's abstract)

BENTHIC FLUX OF NUTRIENT SALTS ON AN INTERTIDAL FLAT,
Tokai Regional Fisheries Research Lab., Tokyo

(Japan). J. Matsukawa, Y. Sato, and K. Sasaki. Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No.6, p 985-989, June 1987. 3 fig, 1 tab, 14 ref.

Descriptors: *Cycling nutrients, *Intertidal areas, *Interstitial water, *Tidal currents, *Benthos, *Nutrient salts, Denitrification, Phosphates, Nitrites, Nitrates, Silicates.

In order to investigate the benthic flux of nutrient salts on intertidal flats and its role on the nutrient circulation, the vertical distribution of nutrient circulation, the vertical distribution of nutrient salts in the interstitial water and its fluctuation with tidal level variation were observed in summer on an intertidal flat in Mikawa Bay. The tidal exchange of the interstitial water, i.e., exudation of the interstitial water from the flat bed in ebb tide and abrupt penetration of the overlying water into the flat bed in flood tide, were strongly suggested. The benthic flux of nutrient salts due to tidal exchange was estimated at about 1.5 me etcm. (so The benthic flux of nutrient salts due to tidal exchange was estimated at about 1.5 mg atom/sq m day for NH4-N, -0.1 mg atom/sq m day for NO2-N + NO3-N, 0.1 mg atom/sq m day for NO2-N + NO3-N, 0.1 mg atom/sq m day for SiO2-Si. The negative value of the flux for NO2-N + NO3-N indicates the denitrification in the sand layer just below the flat surface. The total benthic flux on the flat estimated for N and P are very small compared with the supply from the land, the total net photosynthesis and the total sedimentation evaluated previously through a box model analysis of nutrient budget on the flat. This probably implies that the nutrients supplied onto the flat circulate mostly within the overlying water and living organisms on the flat. The vertical diffusion coefficient corresponding to the benthic flux due to tidal cient corresponding to the benthic flux due to tidal exchange was also estimated at the order of 0.001 sq cm/s which is reasonably large compared with the molecular diffusivity of solute in interstitial

waters generally in the order of 0.000001 to 0.00001 sq cm/s. (Author's abstract) W88-08884

CHEMICAL CHARACTER OF BOTTOM SEDI-MENT AND THE BENTHIC BIOMASS IN ISE AND MIKAWA BAYS, Mie Univ., Tsu (Japan). Faculty of Fisheries. For primary bibliographic entry see Field 5C. W88-0885

EFFECTS OF WATER TEMPERATURE ON FEEDING AND SURVIVAL OF RIGHTEYE FLOUNDERS LIMANDA HERZENSTEINI AND LIMANDA YOKOHAMAE, (IN JAPA-

NESE), Hokkaido Univ., Hakodate (Japan). Faculty of

Fisheries. T. Takahashi, O. Tominaga, and T. Maeda. Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No.11, p 1905-1911, November 1987. 2 fig, 4 tab,

Descriptors: *Flounders, *Water temperature, *Temperature effects, *Fish physiology, *Fish management, Feeding rates, Survival.

Two species of righteye flounder, Limanda herzen-steini (173 to 243 mm in length) and L. yokohamae steini (173 to 243 mm in length) and L. yokohamae (211 to 271 mm in length), were reared under various water temperature conditions, and the effects of temperature on daily feeding and their survival were examined. Although L. herzensteini did not feed at temperatures below 0.7 C, no deaths were observed at the lowest rearing temperature (-0.9 to -1.3 C). L. yokohamae could also tolerate long-term exposure (approximately a weeks) to subzero temperatures (up to -0.5 C), but they ceased to feed at 1.6 to 1.9 C. At temperatures below 18 to 19 C, the daily feeding rate (% wet body weight/day) of L. herzensteini increased with increasing temperature and began to decrease body weight/day) of L. herzensteini increased with increasing temperature and began to decrease remarkably at about 19 C, while in L. yokohamae the temperature at the daily feeding rate began to decrease was about 25 C. In addition, heat resistance experiments suggested that the upper limits of temperature of L. herzensteini and L. yokohamae lay in 25 to 26 C and 28 to 30 C, respectively. Evidently the thermal resistance of these 2 species which often occur sympatrically in the coastal waters of Japan differs considerably, i.e, L. herzensteini is superior in cold resistance, but is inferior in heat resistance to L. yokohamae. (Author's abstract) stract) W88-08887

SCREENING OF BACTERIA WITH ANTI-VIRAL ACTIVITY AGAINST INFECTIOUS HE-MATOPOIETIC NECROSIS VIRUS (HNV) FROM ESTUARINE AND MARINE ENVIRON-

FROM ESTUARING MENTS, Hokkaido Univ., Hakodate (Japan). Faculty of Y. Kamei, M. Yoshimizu, Y. Ezura, and T.

Kimura. Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No. 12, p 2179-2185, December 1987. 2 fig, 8 tab, 23

Descriptors: *Estuarine environment, *Marine environment, *Bacterial analysis, *Fish diseases, *Viruses, *Antibiotics, Antiviral activity.

A total of 748 isolates from estuarine and marine environments were evaluated for antiviral activity against infectious hematopoietic necrosis virus (INHV) according to plaque reduction assay. Among isolates from estuarine environments, 267 (71%) of 376 strains shibited a 50% plaque reduction of IHNV, including 58 strains (18%) able to reduce plaque more than 90%. On the other hand, 120 (32%) of 372 strains from marine environments showed a 50% plaque reduction, including 23 strains (6%) showing a 90% plaque reduction. The incidence of bacteria having antiviral activity in the estuarine isolates was approximately twice that the estuarine isolates was approximately twice that of the marine isolates. Most of the bacteria which exhibited plaque reduction of more than 90% belonged to the genera Pseudomonas, Achromobacter, and Vibrio. A representative strain of

those, Achromobacter sp. 51HW-25, produced antiviral agents heavily when incubated with shaking at 21 C for 60 h. The antiviral products appeared to be two kinds of substances, a thermolabile macromolecule and a thermostable low molecular compound of molecular weight of less than 1,000, when the bacterium was grown at 20 C. However, the bacterium grown at 25 C allowed production of only the low molecular compound. (Author's abstract) W88-08888

SIMULTANEOUS DETERMINATION OF URONIC ACIDS AND ALDOSES IN PLANK-TON, PLANT TISSUES, AND SEDIMENT BY CAPILLARY GAS CHROMATOGRAPHY OF N-HEXYLALDONAMIDE AND ALDITOL ACE-TATES,

Washington Univ., Seattle. School of Oceanogra-

For primary bibliographic entry see Field 2I. W88-08898

FRAMVAREN - ENVIRONMENTAL SETTING, Norsk Inst. for Vannforskning, Oalo.

Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 209-218, April 1988. 10 fig, 1 tab, 10 ref.

Descriptors: *Framvaren Fjord, *Norway, *Anoxic systems, *Fjords, *Estuarine environment, *Estuaries, Meromictic lakes, Glaciation, Pristine environments, Lake sediments

Framvaren, a permanently anoxic fjord on the Framvaren, a permanently anoxic fjord on the southernmost point of Norway, is geomorphologically the result of glaciation and deglaciation. A barrier of glaciofluvial deposit was formed between the open sea and the landlocked water. Due to the isostatic uplift during the deglaciation period, the landlocked water was isolated from the sea and became a meromicitic lake. Around 1850, a channel was out in the barrier and the lake became sea and became a meromicic lake. Around 1830, a channel was cut in the barrier and the lake became a fjord with a sill depth of 2.5 m and a basin depth of 180 m. The fjord is now permanently anoxic below 18 m depth. The tidal amplitude is close to 10 cm. Only 100 people live in the catchment area of Franyaren, hence it may be considered as of Framvaren, hence it may be considered as a natural pristine laboratory ideal for study by marine scientists interested in anoxic systems. (Author's abstract)

WATER EXCHANGE OF FRAMVAREN, Goeteborg Univ. (Sweden). Dept. of Oceanogra-

A. Stigebrandt, and J. Milvaer. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 219-228, April 1988. 8 fig, 2 tab, 4 ref.

Descriptors: *Framvaren, *Fjords, *Estuaries, *Vertical flow, *Density currents, *Seawater, *Model studies, *Density currents, *Salinity, *Saline water, *Water exchange, Helvikfjord, Average volume transport, Mean volume flow, Vertical concentration profiles, Sea level, Norway, Vertical distributionate, Residence time.

The water exchange mechanisms of Framvaren are discussed. The flow in the channel between Framvaren and Helvikfjord is almost completely driven by the fluctuating sea-level difference between the two basins. The average volume transport of seawater into Framvaren is estimated to be about 10 water into Framvaren is estimated to be about 10 cum per sec. Most of the seawater entering Framvaren from Helvikfjord has a low density and may only contribute to the renewal of the upper 10-20 m. The application of a model for a dense bottom current shows the inflowing water should have a salinity of greater than 28% in order to penetrate deeper than 100 m in Framvaren. n 15 out of 21 available observations from Helvikfjord, the surface salinity is less than 20 and the maximum face salinity is less than 20 and the maximum salinity is 25.6%. The authors conclude that many more measurements of the surface salinity in Helvikfjord must be obtained before the residence time of the water at different depths in Framvaren can be estimated. (Author's abstract) W88-08926

Field 2-WATER CYCLE

Group 2L—Estuaries

DISTRIBUTION AND BIOMASS OF PHYTO-PLANKTON AND PHOTOTROPHIC BACTE-RIA IN FRAMVAREN, A PERMANENTLY ANOXIC FJORD IN NORWAY. Norsk Inst. for Vannforskning, Oslo.

Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 229-241, April 1988. 4 fig, 4 tab, 19 ref.

Descriptors: *Biomass, *Phytoplankton, *Fjords, *Framvaren Fjord, *Norway, *Estuaries, *Plank-ton, *Phototropism, *Vertical distribution, Adeno-sine triphosphate, Algae, Bacteria, Photorophic bacteria, Chlorophyll fluorescence, Algal pig-ments, Bacterial pigments.

The vertical distribution and biomass of phyto-plankton and phototrophic bacteria in the perma-nently anoxic fjord, Framvaren in southern Norway, are described. The distribution of algal and bacterial pigments was studied at different seasons in the period from May 1980 to February 1985. The standing crop of phytoplankton was low in the upper part of the euphotic zone, but in-creased near the O2/H2SO4 interface. An algal plate and a dense plate of phototrophic bacteria, measured as chlorophyll fluorescence and scatter-ing were detected near the interface. These plates of phototrophic micro-organisms were found to be of phototrophic micro-organisms were found to be photosynthetically active. Sharp concentration peaks near the interface were also found for the active biomass measured as adenosine triphosphate. (Author's abstract)

DISTRIBUTION OF SOME NON-PHOTOTRO-PHIC BACTERIA AND ACTIVE BIOMASS
(ATP) IN THE PERMANENTLY ANOXIC
FJORD FRAMVAREN,
Norsk Inst. for Vannforskning, Oslo.

Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 243-256, April 1988. I fig, I tab, 17 ref.

Descriptors: "Bacteria, "Estuaries, "Framvaren Fjord, "Anoxic conditions, "Biomass, "Geochemistry, "Adenosine Triphosphate, "Vertical distribution, "Phytoplankton, "Chlorophyll, Biogeocehmistry, Heterotrophic bacteria, Chemoautotrophic bacteria

The vertical distributions of various types of bacteria and active biomass, measured as adenosine tri-phosphate (ATP), in the permanently anoxic fjord Framvaren in southern Norway, were determined during a survey in 1980. High numbers of heterotrophic bacteria were found in association with an trophic bacteria were found in association with a civie biomass of phytoplankton in the upper water layers, but the maximum numbers were found close to the O2/H2SO4 interface. Maximum numbers of chemoautotrophic thiobacilli and total bacterial counts were also found slightly above the interface. The highest concentration of ATP was found at the interface, and these water masses also contained the highest concentration of combined bacterial and algal chlorophyli. The results are discussed with reference to the biogeochemical processes responsible for the anoxic conditions in this fjord. (Author's abstract)

TOTAL PARTICULATE AND ORGANIC FLUXES IN ANOXIC FRAMVAREN WATERS, Norsk Inst. for Vannforskning, Oslo. Norsk Inst. for Vannforskning, Oslo. K. Naes, J. M. Skei, and P. Wassmann. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 257-268, April 1988. 4 fig, 3 tab, 34 ref.

Descriptors: *Framvaren Fjord, *Estuaries, *Fjords, *Anoxic conditions, *Suspended sediments, *Sediments, Particulate matter, *Vertical flow, *Fluctuations, Norway, Mineralization, Annual sediment flux, Organic carbon, Nitrogen.

Cylindrical sediment traps were deployed at vari-Cyningrical secument traps were deployed at various depths in the anoxic water of Framvaren for two periods of one year (1981-1982 and 1983-1984). The traps were emptied three times during 1981-1982 and five times during 1983-84. The vertical fluxes of total suspended material, organic carbon and nitrogen were calculated on a daily and

annual basis. The average annual sediment flux 20 m above the bottom was approximately 60 g per sq m yr and the flux of organic carbon was 20 g per sq m per yr. On the basis of an average C/N ratio of 8 and a constant carbon flux below a depth of 20 m, it is concluded that little mineralization of the organic matter takes place in the anoxic water organic matter takes prace in the anoxic water column. Assuming a primary production of the order to 50-100 g per sq m yr, 22-24% of that reaches the anoxic water masses. Further breakdown of organic matter takes place in the surface sediments. (Author's abstract) W88-08929

PARTITIONING AND ENRICHMENT OF TRACE METALS IN A SEDIMENT CORE FROM FRAMVAREN, SOUTH NORWAY, Norsk Inst. for Vannforskning, Oslo. J. M. Skei, D. H. Loring, and R. T. T. Rantala. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 269-281, April 1988. 2 fig, 4 tab, 33 ref.

Descriptors: *Estuaries, *Framvaren Fjord, *Fjords, *Trace metals, *Sediments, Total metal concentration, Non-detrital metal, Cadmium, Lead, Copper, Zinc, Shales, Plankton, Norway, Bacteria, Sulfides, Solubility.

Extremely high concentrations of Cd, Cu, Pb and Zn were recorded in the bottom sediments of the deep basin of Framvaren. The concentrations are comparable with those found in euxinic mid-Cretacomparable with those found in euxinic mid-Creta-cous black shales. The non-detrital phase (HOAc-extraction) constituted an average of 93, 25, 77 and 89% for Cd, Cu, Pb and Zn, respectively, of the total metal concentrations in the upper sediment. The most plausible explanation for the enrichment of metals is metal sulfide precipitation in the super-anoxic water (maximum 8 millimole per liter total H2S). Metals could also be transferred to the sedi-ments by sinking of occurring matter (plankton and ments by sinking of organic matter (plankton and bacteria) produced in the euphotic zone. The variation in the concentration of the non-detrital metal fraction reflects different solubility products of metal sulfide phases and organic matter associa-tions. (Author's abstract) W88-08930

SULPHUR CHEMISTRY OF A SUPER-ANOXIC FJORD, FRAMVAREN, SOUTH

NORWAY, Goeteborg Univ. (Sweden). Dept. of Analytical and Marine Chemistry. L. G. Anderson, D. Dyrssen, and P. O. J. Hall. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 283-293, April 1988. 6 fig, 3 tab, 15 ref.

Descriptors: *Sulfur cycle, *Framvaren Fjord, *Anoxic conditions, *Fjords, *Estuaries, Isotopes, Sulfides, Sulfates, Carbonates, Norway, Thiols, Oxygen, Density

The concentrations of total carbonate (C sub t), sulfate, sulfide, thiols and oxygen, the ratio between the stable sulfir isotopes S34 and S32 in sulfate and sulfide, and the density (used to calculate salinity) were determined on samples from the water column of Framwaren, a super-anoxic fjord discontinuous Norway Experience of the first the f water column of Framvaren, a super-anoxic tjord in southern Norway. From a depth of 18 m (the oxic-anoxic boundary) the initial sulfate concentration (SO4 sub initi)), as calculated from salinity, is significantly higher then the sum of the measured sulfur species. This is attributed to a loss of sulfur from the water column. The amount of total carbonate produced, corrected for the initial concentration (C sub t - 2.4 Sal/35) is found to be proportional to the amount of sulfate consumed (SO4 sub it). init - SO4) according to the following relation C sub t - 2.4 Sal/35 = 1.84 (SO4 sub init - SO4). Isotopic fractionation caused by bacterial sulfate reduction in the anoxic part of the water column produces sulfide with a S34 approximately 40% lower than the S34 for sulfate at corresponding tower than the \$34 for sultate at corresponding depths. The isotopic fractionation also results in a \$34 value for the remaining sulfate at depths below 80 m being considerably higher than the mean value for ocean water, which is close to +20%. The \$34 values for sulfate at depths between 10 and 50 m were lower than +20% which indicates oxidation od sulfide, which follows upon diffusion. of sulfide from deeper parts of the water column

and inflow of oxygenated seawater over the sill into the anoxic water of the fjord. A conclusive scenario of the Framvaren sulfur chemistry is presented. (Author's abstract)

SEASONAL CYCLING OF SULPHUR AND IRON IN POREWATERS OF A DELAWARE SALT MARSH, Delaware Univ., Lewes. Coll. of Marine Studies.

G. W. Luther, and T. M. Church. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 295-309, April 1988. 3 fig, 2 tab, 43 ref. NSF Grants OCE-8696121 and OCE-8541757.

Descriptors: *Sulfur, *Iron, *Delaware, *Salt marshes, *Marshes, *Pore water, *Wetlands, *Interstitial water, *Oxidation reduction potential, Spring tides, Seasonal variation, Tides, *Pyrite, Pyrite oxidation, Heterotrophy, Autotrophy, Photosynthesis, Reduction, Oxidation, Great Marsh.

An extensive porewater data set has been gathered in the Great Marsh, Delaware over various seasons, salinities and tides. The data all point to a complimentary redox cycle for sulfur and iron which operates seasonally and tidally. Surface oxidizing conditions prevail at depth during the winter. During the spring tides which flood the marsh, pyrite oxidation occurs, releasing excess dissolved iron(II) and sulfate to the porewaters and precipitating authigenic solid iron phases. The redox conditions in the porewaters of the upper zone during the summer are poised between mildly oxidizing and mildly reducing conditions as shown by pE calculations. This redox environment and the intermediate iron-sulfur redox species may be important for the stimulation of plant growth (photosynthesis) and for the sustenance of a viable microbial community (heterotrophy and chemoautotrophy). (Author's abstract)

TEMPORAL VARIATIONS OF SEDIMENTARY SULFUR IN A DELAWARE SALT MARSH, Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.

G. A. Cutter, and D. J. Velinksky. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 311-327, April 1988. 7 fig, 1 tab, 27 ref.

Descriptors: *Sulfur, *Temporal distribution, *Delaware, *Marshes, *Salt marshes, *Cycling nutrients, *Wetlands, *Sediments, *Oxidation reduction potential, *Model studies, Pyrite, Greigite, Sedimentary sulfur, Iron monosulfide, Diagenetic modelling, Great Marsh.

The cycling of sedimentary sulfur was examined over a one year period in the Great Marsh, Delaware using newly developed analytical procedures. Iron monosulfide (FeS) and elemental sulfur both display large seasonal changes in concentration and distribution with depth, indicating a coupling with marsh redox conditions. In contrast, the death distribution and concentration of greight with marsh redox conditions. In contrast, the depth distribution and concentration of greigite (Fe354) did not show appreciable changes with season. Pyrite (FE52) underwent large concentration changes in the upper 15 cm of sediment during the spring, but remained relatively constant with respect to concentration and distribution below this zone. Using a mass balance approach in the upper marsh sediment, sulfur needed for rapid pyritization is found to be derived from elemental unfur iron proposalifes and sulfate reduction. sulfur, iron monosulfide and sulfate reduction. In the deeper sediments, pyritization occurs through a greigite intermediate, and diagenetic modeling in-dicates that pyrite formation is limited by the synthesis of greigite, and not by the conversion of greigite to pyrite. (Author's abstract)
W88-08933

SOLUTION CHEMISTRY OF IRON(II) IN FRAMVAREN FJORD, Florida State Univ., Tallahassee. Dept. of Ocean-

W. M. Landing, and S. Westerlund.
Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p

Estuaries—Group 2L

329-343, April 1988. 5 fig, 3 tab, 28 ref.

Descriptors: *Iron, *Framvaren Fjord, *Cycling nutrients, *Sulfides, *Anoxic waters, *Fjords, *Estuaries, *Vertical distribution, Sediments, Norway, Chemical composition, Solution chemistry, Ferrozine colorimetric method, Equilibrium calculations, Mackinawite, Greigite, Residence time.

A vertical profile of soluble (<0.4 micromolar) Fe(II) from Framvaren Fjord, Norway was determined using an improved Ferozine colorimetric method. Reduced iron concentrations increased dramatically below the 2/H2S interface (20m), reaching a maximum of 890 nM at 30 m. The Fe(II) concentrations then decreased quasi-exponentially to near the detection limit (<0 or = 18 nM) from 110 m to the bottom (183 m). Equilibrium calculations including dissolved iron-bisulfide complexes and five iron-sulfide solid phases indicate that dissolved Fe(II) does not form soluble bisulfide complexes in the deep anoxic waters. The total dissolved Fe(II) below 24 m appear to be controlled by mackinawite (FeS) or greigite (FeS)49, solubility. Changes in the relative rates of vertical diffusive mixing and upwelling due to episodic intermediate water renewal are clearly visible when comparing dissolved Fe(II) profiles. However, the total iron inventory (Dissolved plus particulate) in the fjord has changed only slightly since 1981 (106000 moles in 1985). The resicence time for dissolved Fe(III) in the anoxic waters of the main basin of Framvaren Fjord was calculated assuming that anoxic sediments collect only in the deeper portions of the basin, yielding a value of five years. (Author's abstract)

FORMATION OF FRAMBOIDAL IRON SUL-FIDE IN THE WATER OF A PERMANENTLY ANOXIC FJORD - FRAMVAREN, SOUTH NORWAY

Norsk Inst. for Vannforskning, Oslo.

J. M. Skei. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 345-352, April 1988. 2 fig, 24 ref. NIVA Grant F-80400.

Descriptors: *Iron sulfide, *Iron, *Framvaren Fjord, *Fjords, *Anoxic conditions, *Estuaries, *Sediments, Chemical composition, *Pyrite, Norway, Sulfur, Sulfides, Framboidal iron sulfides.

Framvaren, a super-anoxic fjord in South Norway, has been the subject of research for six years. As part of the scientific program, the chemistry of iron in the water and sediments was investigated. Several particulate iron phases were observed in the anoxic water, including silicate-bound iron from the source rock of the area, finely dispersed amorphous iron sulfide (which bleeds through 0.4 micrometer Nuclepore filters) and framboidal iron sulfide in the size range 3-10 micrometers. Although conclusive mineralogical evidence of framboidal pyrite formation in the water is lacking, several observations support the formation of pyrite at the oxic-anoxic interface where metabolizable organic matter, elemental sulfur and reactive iron are abundant. (Author's abstract) W88-08935

CYCLING OF MANGANESE IN THE PERMA-NENTLY ANOXIC DRAMMENSFJORD, Oslo Univ. (Norway). Biologisk Inst. M. Schaanning, K. Naes, P. K. Egeberg, and F.

Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 365-382, April 1988. 7 fig, 3 tab, 35 ref.

Bome.

Descriptors: *Manganese, *Drammensfjord, *Sediments, *Fjords, *Anoxic conditions, *Cycling nutrients, *Estuaries, *Turnover time, *Oxidation reduction potential, Geology, Chemical composition, Norway, Rhodochrosite, Correlation anallysis, Dissolved manganese, Particulate manganese.

Sampling of manganese in sediment traps, water column and sediments in the Drammensfjord, southeast Norway, has given a consistent data set

on dissolved and particulate Mn in a permanently anoxic fjord. In the water column, variable shapes of the vertical profiles resulted in hydrodynamic processes and redox boundary fluctuations. Independent flux estimates from sediment-trap data and water-column budget both gave a turnover time of manganese in the anoxic water mass of 7-9 years. Steady state in the anoxic layer was probably maintained by diffusion of Mn(++) ions and precipitation at the sediment surface. Saturation with respect to rhodochrosite was observed at the middepth maxima and in the pore-water at the sediment surface. In the sediment, linear-regression analyses showed positive correlation between manganese and carbonate. Manganese-enriched horizons, resulting from recycling at ancient redox boundaries, were observed within the reducing deep-basin sediment. Lead-210 dating indicated that the upper horizon was deposited by the turn of the century when organic loading increased as a result of the establishment of the pulp industry in the watershed area. (Author's abstract)

MODELLING THE MANGANESE CYCLING IN TWO STRATIFIED FJORDS, Oslo Univ. (Norway). Dept. of Geology.

N IWO SIRATIFIED FAURS, OSlo Univ. (Norway). Dept. of Geology. P. K. Egeberg, M. Schanning, and K. Naes. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 383-391, April 1988. 5 fig. 11 ref.

Descriptors: *Manganese, *Fjords, *Estuaries, *Model studies, Cycling nutrients, *Oxidation reduction potential, *Stratification, Parametric modelling, Particulate manganese, Mathematical models, Framvaren Fjord, Drammensfjord, Norway, Dissolved manganese, Manganese cycle, Eddy diffusion coefficients.

This paper presents a parameterized model for the particulate and dissolved manganese profiles in two stratified fjords (Drammensfjord and Framvaren Fjord, Norway). Rates of oxidation and reduction of manganese are of the order of 1.0 times ten to the minus 15th power mol per cu cm/sec. Oxidation of manganese is probably not promoted by an inorganic surface-catalyzed reaction. Cycling of manganese in the redox cline is extensive (10-100 cycles) and is related to the input of manganese to the fjords. Calibration of the model against sediment-trap data allow instantaneous eddy diffusion coefficients to be estimated. These are of the order of 0.01 and .0001 sq cm per sec. (Author's abstract)

DISTRIBUTIONS OF URANIUM, RADIUM AND THORIUM ISOTOPES IN TWO ANOXIC FJORDS: FRAMVAREN FJORD (NORWAY) AND SAANICH INLET (BRITISH COLUMBIA), South Carolina Univ., Columbia. Dept. of Geological Sciences.

hear sciences. J. F. Todd, R. J. Elsinger, and W. S. Moore. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 393-415, April 1988. 12 fig, 3 tab, 64 ref. NSF Grant OCE 80-18189.

Descriptors: *Uranium, *Fjords, *Radium, *Thorium, *Anoxic conditions, *Isotopes, *Framvaren, *Saanich Inlet, *British Columbia, *Geochemistry, *Radioisotopes, Marine geology, Norway, Radionalidad.

Depth profiles of the naturally-occurring radionuclides U238, U234, Ra226, Ra226 and Th228 were obtained in two diverse anoxic marine environments; the permanently anoxic Framvaren Fjord in southern Norway and the intermittently anoxic Saanich Intet in British Columbia. Concentrations of total H2S were over three orders of magnitude greater in the anoxic bottom waters of the Framvaren Fjord compared to those in Saanich Inlet. In Framvaren Fjord, the O2/H2S interface was located at 17 m. While dissolved U238 behaved conservatively throughout the oxic and anoxic oceanic water columns, concentrations based on the U238/salinity ratio in oxic oceanic waters were almost 30% lower. Dissolved Ra226 displayed a sharp maximum just below the O2/H2S interface, coinciding with dissolved Mn(II) and Fe(II) maxima in this zone. It is suggested that reductive dissolution

of Fe-Mn oxyhydroxides remobilizes Ra226 in this region. In Saanich Inlet, the O2/H2S interface was located at 175 m. Dissolved U238 displayed a strongly nonconservative distribution. The depth profiles of dissolved Mn(II) in the suboxic waters above the O2/H2S interface, suggesting that reduction of particulate Mn regulates the behavior of Ra226 and Th228 in this region. Removal residence times for dissolved Th223 in the surface oxic waters of both systems are longer than generally reported for particle-reactive radionuclides in coastal marine environments. In the anoxic waters of Framwaren Fjord and Saanich Inlet, however, the dissolved Th228 removal residence times are quite similar to values reported for dissolved Pb210 in the anoxic waters of the Cariaco Trench and the Orca Basin. This implies that the geochemistries of Th and Pb may be similar in anoxic marine waters. (Author's abstract)

TRACE METALS IN THE WATER COLUMNS OF THE BLACK SEA AND FRAMVAREN FJORD,

Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.

C. Haraldsson, and S. Westerlund. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 417-424, April 1988. 3 fig. 3 tab, 13 ref.

Descriptors: *Fjords, *Estuaries, *Trace metals, *Anoxic conditions, *Heavy metals, *Particulate matter, Cadmium, Copper, Nickel, Lead, Zinc, Cobalt, Manganese, Iron, Particulate metal analysis, Framvaren, Black Sea, Norway.

The trace metals cadmium, copper, nickel, lead, zinc, cobalt, iron, and manganese from the oxic and anoxic water columns of the Black Sea and Framwaren Fjord are reported. The importance of particulate metal analysis is shown by data for the anoxic Framwaren Fjord, which acts as a trap for trace metals. A major fraction of Cd, Cu, Pb, Zn, and Fe in the Black Sea is found in particles, whereas the particulate fraction is smaller in Framwaren. The high fraction of metals bound to particulate matter may account for the failure of equilibrium calculations with this type of water. Framwaren acts on effective trap for most of the trace metals transported to the fjord by fresh waters. (Author's abstract)

SOME PECULIARITIES OF THE TRACE-METAL DISTRIBUTION IN BALTIC WATERS AND SEDIMENTS,

Akademie der Wissenschaften der DDR, Rostock-Warnemuende. Inst. fuer Meereskunde.

L. Brugmann. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 425-440, April 1988. 5 fig, 3 tab, 29 ref.

Descriptors: *Trace metals, *Sediments, *Baltic Sea, *Suspended sediments, *Path of pollutants, *Water pollution sources, *Heavy metals, *Estuaries, *Anoxic conditions, Flocculation, Sediment cores, Vertical distribution, Cadmium, Copper, Cobalt, Iron, Mercury, Manganese, Nickel, Lead, Zinc.

Between 1980 and 1984, extensive studies were carried out in the Baltic Sea on trace metals (Cd, Co, Cu, Fe, Hg, Mn, Ni, Pb and Zn) in water, suspended matter and sediments. The results enable the influence of different factors on metal distribution patterns to be considered. The vertical profiles of dissolved and particulate metals in waters of the central deep basins reflect influences caused by oxygen deficiency and anoxic conditions in nearbottom water layers. Peculiarities at a station in the Gotland Deep included high dissolved Fe, Mn and Co concentrations and remarkable enrichment of Zn (0.64%), Cd (51 micrograms per gram) and Cu (0.15%) in particulate matter from the anoxic zone. Manganese-rich particles were accumulated above this layer. In fine-grained soft sediments below anoxic deep waters, maximum contents of Cd, Cu, and Zn were observed, relative to other coring sites, between Bothnian Bay and Lubeck Bight.

Field 2—WATER CYCLE

Group 2L—Estuaries

The Hg content in sediments probably reflects the joint flocculation with organic matter. Land-based sources seem to play the leading part for maximum lead contents. (Author's abstract)

MERCURY IN THE NORWEGIAN FJORD FRAMVAREN,

Swedish Environmental Research Inst., Goete-

For primary bibliographic entry see Field 5B. W88-08941

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

NEW COMPOSITE CHARGED REVERSE OS-MOSIS MEMBRANE, Nitto Electric Co. Ltd., Osaka (Japan). K. Ikeda, T. Nakano, H. Ito, T. Kubota, and S. Desalination DSLNAH, Vol. 68, No. 2-3, p 109-119, March 1988. 12 fig, 3 tab, 4 ref.

Descriptors: "Membranes, "Permselective membranes, "Reverse osmosis, "Water treatment, "Water treatment facilities, Chlorine, Membrane processes, Fouling, Ion exchange, Permeability, Selectivity, Electrolytes, Hydrogen ion concentration, Salts, Cations, Solutes, Amino acids, Anions, Pulp wastes, Wastewater treatment, Wastewater facilities.

The performance of membranes of the NTR-7400 series is controlled by the ion-exchange capacity of the skin layer, and by the method of making the membrane. Typically the thickness of the skin layer is about 0.3 micrometers as measured by transmission electron microscopy. These membranes have very high water permeabilities and are resistant to chemical attack. In particular, the membranes are stable to 10,000 ppm chlorine for I month. The membranes exhibit a stable performance over a wide pH range, from pH 1 to pH 13 month. The membranes exhibit a stable perform-ance over a wide pH range, from pH 1 to pH 13 even at 80 C for 1 month. The membrane's selec-tivity properties are rather unusual. Salts contain-ing monovalent cations have higher rejections than salts containing divalent cations. This is the oppo-site of most normal reverse-osmosis membranes. Salt-rejection decreases rapidly with increasing salt concentration, but flux is independent of salt con-centration. On the other hand, the rejection of neutral solutes is constant over a wide range of centration. On the other hand, the rejection of neutral solutes is constant over a wide range of concentration. The rejection of amphoteric electrolytes, such as amino acids, depends on pH and increases rapidly at a pH higher than the isoelectric point of the amino acids. The rejection of negatively-charged solutes such as ATP is high. Spiral-wound modules incorporating these mem-branes have been used to decolor soy-sauce solutions. Tubular modules incorporating these mem-branes have been used effectively in the treatment of pulp and paper waste waters. The membranes are particularly resistant to fouling by anionic species. (Author's abstract) W88-08137

ACIDIC WASTEWATER TREATMENT BY DONNAN DIALYSIS INVOLVING TUBULAR ANION-EXCHANGE MEMBRANES, Wrocław Technical Univ. (Poland). Inst. of Environment Protection Engineering.
For primary bibliographic entry see Field 5D.
W38-08138

SUBSTITUTION OF THE FINAL CLARIFIER BY MEMBRANE FILTRATION WITHIN THE ACTIVATED SLUDGE PROCESS WITH IN CREASED PRESSURE: INITIAL FINDINGS. Stuttgart Univ. (Germany, F.R.). Inst. fuer Sied-lungswasserbau, Wasserguete- und Abfallwirtschaft For primary bibliographic entry see Field 5D. W88-08139

NITRATE REMOVAL BY ELECTRODIALYSIS FOR BREWING WATER,

GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.) For primary bibliographic entry see Field 5F.

3B. Water Yield Improvement

CONSERVATION PROBLEMS AND MANAGE-MENT OPTIONS IN ESTUARIES: THE BOT RIVER ESTUARY, SOUTH AFRICA, AS A CASE-HISTORY FOR MANAGEMENT OF CLOSED ESTUARIES,

Cape Town Univ. (South Africa). Dept. of Zoology. For primary bibliographic entry see Field 2L. W88-08216

FUTURE WATER SUPPLY IN THE MACHA-KOS DISTRICT OF KENYA, Reading Univ. (England). Dept. of Geography. S. K. Mutiso, and R. D. Thompson. AMBIO AMBOCX, Vol. 16, No. 6, p 322-325, 1987. 2 fig. 3 tab, 17 ref.

Descriptors: *Water supply development, *Water resources development, *Kenya, *Developing countries, Water demand, Domestic water, Irrigation water, Groundwater quality, Human populations, Seasonal distribution, Agriculture, Surveys,

Most African governments are aiming to provide a supply of clean and safe water for rural people by the year 2000. Faced with a rapid population growth rate of 4% per annum (the highest in the world) and limited high-potential agricultural land, the Kenyan government recognizes the need to examine the problems and prospects of developing the water resources of the marginal, semiarid areas for agricultural and domestic use. Wise management of the scarce resources of these areas entails an understanding of the factors which influence supply and demand of water and is a matter of urgency. Few studies exist on total or per capita water consumption in rural areas. The results are presented for a recent survey of rural agricultural and domestic water consumption in the Machakos district, an ecologically marginal area of Kenya. Streams are the main source of both agricultural (71%) and domestic (54%) water supply. The most critical water-balance component influencing agricultural yields is rainfall; rainfall amounts are low, with a strong seasonal concentration. Since the World Health Organization recommended limit of 500 mg/L for total dissolved solids in groundwater used for drinking is exceeded in the majority of the water consumption in rural areas. The results are Sto mg/L for total assolved solids in groundwater used for drinking is exceeded in the majority of the boreholes, and the permissible fluoride limit of 1.5 mg/L is also exceeded in more than half of the samples, it is evident that the quality of drinking water is a problem in the Machakos district. (Sand-PTT) PTT) W88-08232

NEGLECTED WATER RESOURCE: THE CA-MANCHACA OF SOUTH AMERICA, Atmospheric Environment Service, Downsview

R. S. Schemenauer, H. Fuenzalida, and P. Cereceda

Bulletin of the American Meteorological Society BAMIAT, Vol. 69, No. 2, p 138-147, February 1988. 13 fig, 4 tab, 22 ref.

Descriptors: *Fog. *Water supply development, *Chile, *Available water, *Climatology, Hydrology, Geology, Cloud water, Precipitation, Groundwater, Coastal stratocumulus, Cost analysis, Ca manchaca, South America.

Many parts of the world are currently suffering water shortages. Few areas, however, have as little precipitation and groundwater available to allevi-ate the problem as does the northern coast of Chile. The historical background of the attempts to collect water directly from the coastal stratocumulus decks is reviewed as are the meteorological and geographical considerations important to the col-

lection of the cloud water. Calculations of water availability and cost indicate that this may well be an important source of water for some coastal regions. A combined research and applied project to study the properties of high-elevation fogs and their use as a water supply will be conducted by Chilean and Canadian agencies from late 1987 to the end of 1988. (Author's abstract)

INTERCEPTION AND STORAGE OF SURFACE RUN-OFF IN PONDS IN SMALL AGRICULTURAL WATERSHEDS, ANDHRA PRADESH, INDIA,

Central Research Inst. for Dryland Agriculture, Hyderabad (India). For primary bibliographic entry see Field 3F. W88-08594

INVESTIGATION INTO UNCONVENTIONAL SOURCES OF WATER FOR A PERI-URBAN/RURAL DISTRICT OF KWAZULU, Natal Univ., Pietermaritzburg (South Africa). Dept. of Crop Science. For primary bibliographic entry see Field 5F. W88-08852

3C. Use Of Water Of Impaired Quality

APPLICATION OF INVESTMENT TIMING ANALYSIS: DUAL WATER SYSTEMS, Marsan (Andre) et Associes, Inc., Montreal

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 247-253, April 1988. 3 fig. 4 tab, 22 ref.

Descriptors: *Dual water systems, *Cost-benefit analysis, *Investment, *Economic aspects, *Model studies, *Water supply systems, Mathematical stud-ies, Utah, West Jordan.

general methodology to study the economics of al water systems (defined here as a separate A general methodology to study the economics of dual water systems (defined here as a separate distribution system for untreated low quality local surface water for outdoor municipal water supply) is summarized and the application of the method to a rapidly growing city is presented. In the first step, a cost-benefit criterion for evaluating dual systems is developed. The criterion is then extended to a dynamic case where the population to be served increases with time and where the dual system is allowed to expand. The optimal investment time to introduce the dual water supply project is obtained by maximizing social welfare. The model is applied to the city of West Jordan, Utah, where a dual system is currently being proposed. Model results indicate that for the city as a whole dual supply is not economically feasible. However, when the model is applied to a part of the city, it is found feasible and the optimal time to initiate the project would be in the year 1989. (Author's abstract) W88-08029

CADMIUM SULFATE APPLICATION TO SLUDGE-AMENDED SOILS: I. EFFECT ON YIELD AND CADMIUM AVAILABILITY TO PLANTS,

Textus, Arkansas Univ., Marianna. Eastern Arkansas Soil Testing and Research Lab. For primary bibliographic entry see Field 5C. W88-08069

TREES AND SHRUBS FOR CONTROL OF TANNERY WASTEWATER IN INDIA, Conservator of Forests, Research and Development, Lucknow (India). For primary bibliographic entry see Field 5E. W88-08213

SALINIZATION OF RIVERS AND STREAMS: AN IMPORTANT ENVIRONMENTAL AN IN HAZARD.

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Conservation In Agriculture—Group 3F

Adelaide Univ. (Australia). Dept. of Zoology. For primary bibliographic entry see Field 5B. W88-08224

DEVELOPMENT OF WATER REUSE IN ISRAEL.

H. I. Shuval.

AMBIO AMBOCX, Vol. 16, No. 4, p 186-190,

1987. 4 fig. 14 ref.

Descriptors: "Water resources development, "Wastewater disposal, "Water reuse, "Recycling, Wastewater irrigation, Israel, Social aspects, Eco-nomic aspects, Political aspects, Public health.

Israel is a semiarid country that has fully developed all of its conventional water resources in a carefully planned program designed to achieve maximum development of the country's agricultural potential. Today the main source for developing additional water resources for agriculture is the al potential. Today the main source for developing additional water resources for agriculture is the recycling of wastewater for irrigation. This paper traces the development of the Israeli wastewater reuse program, which has now been declared a national policy, with some 35% of Israel's total wastewater flow recycled for agricultural and industrial use in 1986. The goal is to achieve 80% reuse by the year 2000. Agronomic, engineering, sociopolitical and health aspects of the development of wastewater reuse in Israel are analyzed. (Author's abstract) (Author r's abstract)

WATER REUSE SYSTEMS: A REVIEW OF PRINCIPAL COMPONENTS,
Fish and Wildlife Service, Cook, WA. Willard

Fish and winding Service, Cook, WA. William Field Station.
G. L. Luchetti, and G. A. Gray.
The Progressive Fish-Culturist PFCUAY, Vol. 50, No. 1, p 1-6, January 1988. 60 ref.

Descriptors: *Wastewater renovation, *Water treatment, *Water reuse, *Aquaculture, *Fish farming, Disease control, Temperature control, Ammonia removal.

Principal components of water reuse systems in-clude ammonia removal, disease control, temperaclude ammonia removal, disease control, tempera-ture control, aeration, and particulate filtration. Effective ammonia removal techniques include air stripping, ion exchange, and biofiltration. Selection of a particular technique largely depends on site-specific requirements (e.g., space, existing water quality, and fish densities). Disease control, though often overlooked, is a major problem in reuse systems. Pathogens can be controlled most effec-tively with ultraviolet radiation, ozone, or chlo-rine. Simple and inexpensive methods are available to increase oxygen concentration and eliminate gas to increase oxygen concentration and eliminate gas supersaturation, these include commercial aerators, air injectors, and packed columns. Temperature control is a major advantage of reuse systems, but control is a major advantage of reuse systems, but the equipment required can be expensive, particu-larly if water temperature must be rigidly con-trolled and ambient air temperature fluctuates. Fil-tration can be readily accomplished with a hydro-cyclone or sand filter that increases overall system cyctone or sand filter that increases overall system efficiency. Based on criteria of adaptability, efficiency, and reasonable cost, components of a small water reuse system are recommended. (See also W88-0845) (Author's abstract)

PROTOTYPE WATER REUSE SYSTEM, Fish and Wildlife Service, Cook, WA. Willard Field Station.

G. L. Luchetti, and G. A. Gray. The Progressive Fish-Culturist PFCUAY, Vol. 50, No. 1, p 46-49, January 1988. 2 fig, 8 ref.

Descriptors: *Wastewater renovation, *Water treatment, *Water reuse, *Aquaculture, *Northern Squawfish, Disease control, Temperature control, Fisheries, Prototypes.

A small-scale water reuse system (150 L per min) was developed to create an environment for observing fish under a variety of temperature regimes. Key concerns of disease control, water

quality, temperature control, and efficiency and ease of operation were addressed. Northern squawfish (Ptychocheilus oregonensis) were held at loading densities ranging from 0.11 to 0.97 kg per 1 per min and at temperatures from 10 to 20 degrees for months with no disease problems or degradation of water quality in the system. The system required little maintenance during 2 years of operation. (See also W88-08544) (Author's abstract)

CHEMICAL CHARACTERISTICS OF THE WATER IN THE RICEFIELDS OF THE EBRO DELTA (N.E. SPAIN),

Barcelona Univ. (Spain). Dept. de Ecolog For primary bibliographic entry see Field 2H. W88-08809

DISSOLVED ORGANIC MATTER IN COL-ORED WATER FROM MOUNTAIN BOG POOLS IN JAPAN: II. BIOLOGICAL DECOM-

POSABILITY, Yamagata Univ. (Japan). Dept. of Chemistry. For primary bibliographic entry see Field 2H. W88-08810

3D. Conservation In Domestic and Municipal Use

RESIDENTIAL WATER DEMAND IN METRO MANILA,

For primary bibliographic entry see Field 6D. W88-08033

FUTURE WATER SUPPLY IN THE MACHA-KOS DISTRICT OF KENYA, Reading Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 3B.

3F. Conservation In Agriculture

ALGORITHM FOR THE CALCULATION OF DRAIN SPACINGS FOR LAYERED SOILS, Polish Academy of Sciences, Lublin. Inst. Agrofizvki. For primary bibliographic entry see Field 2G. W88-07987

NITROGEN TRANSPORT DURING DRIP FER-TIGATION WITH UREA, Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant

Physiology. For primary bibliographic entry see Field 2G. W88-07989

SPATIAL AND TEMPORAL DISTRIBUTION OF SOIL WATER IN THE TILLED LAYER UNDER A CORN CROP,

Guelph Univ. (Ontario). Dept. of Land Resource

For primary bibliographic entry see Field 2G. W88-07992

EFFECTS OF SOIL AND NITROGEN ON WATER USE EFFICIENCY OF TALL FESCUE AND SWITCHGRASS UNDER HUMID CONDI-

Agricultural Research Service, University Park, PA. Regional Pasture Research Lab. For primary bibliographic entry see Field 2I. W88-07995

ROOT GROWTH IN A CLAYPAN WITH A PERENNIAL-ANNUAL ROTATION,

Kansas Agricultural Experiment Station, Manhat-tan. Evapotranspiration Lab. For primary bibliographic entry see Field 2I. W88-07997

OPTIMAL DESIGN OF FIELD EXPERIMENTS FOR DETERMINATION OF PRODUCTION FUNCTIONS.

Stichting voor Bodemkartering, Wageningen (Netherlands). Dept. of Soil Physics and Hydrolo-

M. H. Hendrickx, P. J. Wierenga, and N. S. Urquhart.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 494-499, March-April 1988. 4 fig, 3 tab, 17

Descriptors: *Production functions, *Optimization, *Field tests, *Experimental design, Desing criteria, Design standards, Model studies, Mathematical studies, Hydrology, Equations, Statistical analysis.

A technique was needed to assess the optimal number and size of experimental plots for detection of the shape of a production function with confidence intervals of specified length. Therefore, an equation was developed to evaluate the optimal number of replications and the optimal plot size for field experiments with structured quantitative treatments. Use of the equation is illustrated with experimental designs for determination of water production functions of trickle irrigated chile peppers (Capsicum annuum L., var. New Mexico no. 6-4). Input variables for the equation are the variance, error degrees of freedom, plot size of a previous experimental plots of a previous experiment approach experimental plots of a previous experiment expressed in a coefficient b, size of the difference to be detected, assurance with which is it desired to detect the difference, and level of significance to A technique was needed to assess the optimal to detect the difference, and level of significance to be used in a future experiment. Application of the equation showed that, for detection of small differences, optimization of the plot size becomes importhat. In our sample experiment we found that a four-fold increase in experimental plot size decreased the total number of plots from 156 to 42, but increased the total experimental area by only 8%. (Author's abstract)

SOIL MODULUS OF RUPTURE AS AFFECT-ED BY WETTING UNDER VACUUM,
Agriculture and Water Resources Research
Centre, Baghdad (Irag).

For primary bibliographic entry see Field 8D. W88-08001

VARIABILITY OF SOIL WATER PROPERTIES AND CROP YIELD IN A SLOPED WATER-SHED,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab. For primary bibliographic entry see Field 2G. W88-08034

IRRIGATION WATER DELIVERY SYSTEM OPERATION VIA AGGREGATE STATE DYNAMIC PROGRAMMING,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.

R. J. Houghtalen, and J. C. Loftis.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 427-434, April 1988. 1 fig, 3 tab, 12 ref.

Descriptors: *Water delivery, *Dynamic programming, *Water demand, *Aggregate state dynamic programming, *Irrigation engineering, *Irrigation water, Computer programs, Model studies, Stochastic process, Mathematical studies, Prediction, Optimization, Reservoirs.

A modified dynamic programming (DP) approach that is called aggregate state dynamic programming (ASDP) is presented to optimally operate irrigation water delivery systems. ASDP can be applied to multiple reservoir systems without encountering dimensionality problems. In addition, the random nature of water supply and consumptions of the consumption of t the random nature of water supply and consump-tive crop demands can be incorporated into the technique. A case study is presented to display the application of ASDP. Using a sum-of-squared-shortages objective, ASDP outperforms a tradi-tional separation technique and approaches the the-oretical (ideal) optimum. Problem settings that are

Field 3-WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation In Agriculture

conducive to the use of ASDP and limitations of the technique are presented. (Author's abstract) W88-08051

SIZE DISTRIBUTION OF ERODED SEDI-MENT FROM TWO TILLAGE SYSTEMS, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2J. W88-08054

VERIFICATION OF A MODEL PREDICTING SEDIMENT LEVEL IN SUBSURFACE DRAINS, Laval Univ., Quebec. Dept. of Soil Science. For primary bibliographic entry see Field 2J. W88-08055

SPATIAL TRENDS AND VARIABILITY OF SOIL PROPERTIES AND CROP YIELD IN A SMALL WATERSHED, Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab. For primary bibliographic entry see Field 2J. W88-08056

DESIGN AND EVALUATION OF REGIONAL WEATHER MONITORING NETWORKS, Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering. For primary bibliographic entry see Field 7A. W88-8083

TWO-STAGE WEIR CONTROL OF SUBSUR-FACE DRAINAGE FOR WATER TABLE MAN-

FACE DRAINAGE FUR WALER JORGE, AGEMENT, AGEMENT, Search Service, Baton Rouge, LA. Soil and Water Pollution Research Unit. J. L. Fouss, R. W. Skagea, and J. S. Rogers. American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1713-1719, November-December 1987. 9 fig. 2 tab, 10 ref.

Descriptors: *Subsurface drains, *Hydrologic models, *Water table management, *Model studies, *Drainage systems, *Simulation, Prediction, Drainage engineering, Irrigation engineering, Two-stage weirs, Mathematical models, Soil water, DRAINMOD, Gulf Coast, Weirs.

A simulation model was developed for field water table control when subsurface drainage flow is regulated with an automatic two-stage' weir at the drainage outlet. Simulation results were compared with predicted water table drawdown for convenwith predicted water table drawdown for conventional drainage (no outlet control) and drainage controlled with a 'fixed' elevation weir. Simulations were made for the operation of the two-stage weir under controlled-drainage and subirrigation conditions for a 20-year period of climatological record (Gulf Coastal Area) by modifying the water management model, DRAINMOD: Simulations showed that use of the two-stage weir would allow a drain spacing of 20 m for a Commerce silt loam soil with good surface drainage. If a fixed-weir was used the drain spacing would have to be 15 to 16 m to achieve the same degree of protection from excess soil-water conditions. The 20 m spacing was adequate to meet subirrigation requirements. (Alexander-PTT)

ANALYSIS OF CENTER PIVOT IRRIGATION SYSTEMS OPERATING IN A HUMID-AREA ENVIRONMENT, Auburn Univ., AL. Dept. of Agricultural Engi-

G. C. Johnson, E. W. Rochester, L. U. Hatch, L. M. Curtis, and K. H. Yoo.

M. Curtis, and K. H. Yoo.

M. Cartis, and K. H. Yoo.

Merican Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1720-1725, November-December 1987. 10 fig, 3 tab, 14 ref.

Descriptors: *Sprinklers, *Irrigation requirements, *Center pivot irrigation systems, *Simulation analysis, *Humid areas, *Model studies, *Irrigation engineering, Economic aspects, Mathematical studies, Agriculture, Irrigation, Southeastern United States, Peanuts, Costs.

A simulation model was developed to assist in evaluating the most economic sprinkler package to utilize with center pivot irrigation under Southeastern U.S. conditions. Of particular interest was the effect on the selection process of relatively low total annual application depths found in humid areas as compared to higher application depths found in arid areas. Other variables included were soil type and system size. Plant response for a single crop, peanuts, was used in the analysis. Results in the form of net returns are presented with the most economic sprinkler package selec-Results in the form of net returns are presented with the most economic sprinkler package selections noted. In the comparison of total annual application depths, 25-cm and 30-cm irrigation requirements were evaluated. In general, sprinkler package selection was less critical for the 25-cm total annual application as compared to the 50-cm application, in many cases, lower pressure sprinkler packages could be utilized at the lower annual irrigation requirement. (Alexander-PTT) W88-08065

POTENTIAL EXPANSION AND WATER DEMAND OF RIPARIAN-BASED IRRIGA-TION, Florida Univ., Gainesville. Dept. of Agricultural

Engineering.
For primary bibliographic entry see Field 6D.
W88-08066

EFFECT OF POLYETHYLENE MULCHES, IR-RIGATION METHOD, AND ROW COVERS ON SOIL AND AIR TEMPERATURE AND YIELD OF MUSKMELON, North Carolina State Univ., Raleigh. Dept. of Hor-ticultural Science.

ticultural Science.
A. R. Bonanno, and W. J. Lamont.
Journal of the American Society for Horticultural
Science JOSHB5, Vol. 112, No. 5, p 735-738, September 1987. 5 tab, 20 ref.

Descriptors: *Mulches, *Mulching, *Irrigation effects, *Polyethylene mulches, *Row covers, *Cropyield, Soil temperature, Air temperature, Muskmelons, North Carolina, Mulches, Temperature effects, Irrigation practices, Sprinkler irrigation, Trickle irrigation, Irrigation, Plant growth.

Field studies were conducted in 1984 and 1985 to rieta stuaies were conducted in 1984 and 1985 to document the effects of plastic mulches and row covers on soil and air temperatures and yield of muskmelons (Cucumis melo L.) in North Carolina. Treatments included bare ground, black plastic, and clear plastic, each with and without a slitted clear plastic row cover. In addition, both trickle clear plastic row cover. In addition, both trickle and overhead sprinkler irrigation were evaluated. Soil temperatures were increased by plastic mulches, with clear polyethylene resulting in the highest soil temperatures. Air temperatures were increased by row covers. In 1984, total and early yields were increased over bare ground plots with the use of either clear or black polyethylene mulches. Row covers did not influence yields. In 1985, a warmer year than 1984, no total yield increases resulted from use of either row covers on mulches; however, row covers and clear plastic mulches; however, row covers and clear plastic mulch increased early yield. Trickle irrigation used less water than did overhead irrigation, but did not increase yields. (Author's abstract) W88-08115

EFFECTS OF DROUGHT ON HOST AND EN-DOPHYTE DEVELOPMENT IN MYCORRHI-ZAL SOYBEANS IN RELATION TO WATER USE AND PHOSPHATE UPTAKE,

Agricultural Research Service, Albany, CA. West-ern Regional Research Center For primary bibliographic entry see Field 2I. W88-08144

DEVELOPMENT OF WATER REUSE IN

ISRAEL, Hebrew Univ. of Jerusalem (Israel). For primary bibliographic entry see Field 3C. W88-08225

MEETING DROUGHT: A MICRO WATER-SHED DEVELOPMENT APPROACH,

Tata Inst. of Fundamental Research, Bombay For primary bibliographic entry see Field 6F. W88-08229

FUTURE WATER SUPPLY IN THE MACHA-KOS DISTRICT OF KENYA,

Reading Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 3B. W88-08232

EXPLICIT INFILTRATION EQUATIONS BASED ON THE GREEN-AMPT MODEL. Saskatchewan Univ., Saskatoon, Dept. of Agricul-

Saskatchi Wall of Agricultural Engineering.
For primary bibliographic entry see Field 2G. W88-08306

ANALYTICAL SOLUTION FOR FLOW IN A MANIFOLD,

Arizona Univ., Tucson. Dept. of Soil and Water

A. W. Warrick, and M. Yitayew. Advances in Water Resources AWREDI, Vol. 10, No. 2, p 58-63, June 1987. 4 fig, 14 ref, append.

Descriptors: *Trickle irrigation, *Flow, *Turbu-lent flow, *Laminar flow, *Manifelds, Mathematical analysis.

The interest in manifold is primarily for trickle irrigation laterals, but the solution has broader applications including those for which pressure increases in the direction of flow and for intake manifolds. Both velocity head losses and variable discharge along the manifold are considered in the fundamental analysis. The appropriate second order, nonlinear equation is solved for two flow regimes, laminar and fully turbulent. Results indicate that for most trickle irrigation laterals the velocity head loss is negligible, but for an example from a chemical processing system the effect is important. (Author's abstract)

NUMERICAL ANALYSIS OF THE EFFECTS OF AQUATIC WEEDS ON THE PERFORM-ANCE OF IRRIGATION CONVEYANCE SYS-

Calgary Univ. (Alberta). Dept. of Civil Engineer-

D. H. Manz, and D. R. Westhoff. Canadian Journal of Civil Engineering CJCEB8, Vol. 15, No. 1, p 1-13, 1988. 13 fig, 2 tab, 14 ref.

Descriptors: *Irrigation canals, structures, *Aquatic weeds, Plants, Algae, Simula-tion analysis. Channel flow, Numerical analysis.

Aquatic weeds growing in irrigation conveyance systems of the earth-lined, open-channel type retard the flow and reduce the efficiency of the systems. The weed infestations, consisting of both submerged and emergent vascular plants and algae, also reduce system capacity and may result in increased seepage and spill losses. The flow retardance effects and their impacts on the performance of the irrigation conveyance system are evaluated using a modified version of the irrigation convey. using a modified version of the irrigation convey-ance system simulation (ICSS) model developed at the University of Calgary. (Author's abstract)

INFLUENCE OF UNDERCANOPY SPRIN-KLER AND DRIP IRRIGATION SYSTEMS ON GROWTH AND YIELD OF BANANAS (CULTI-VAR WILLIAMS') IN THE SUBTROPICS,

Citizens Response Co., New York. J. C. Robinson, and A. J. Alberts. Scientia Horticulturae SHRTAH, Vol. 32, No. 1/ 2, p 49-66, June 1987. 7 fig, 2 tab, 30 ref.

Descriptors: *Drip irrigation, *Sprinkler irrigation, *Plant growth, Subtropic zone, Banana, Yield, Drought, Seasonal variation, Temperature effects.

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Conservation In Agriculture—Group 3F

The influence of drip and undercanopy sprinkler irrigation on growth and yield of bananas was investigated over three crop cycles. In the first and second ratoon cycles (RI and R2), irrigation water quantities were equalized between systems and were sufficient to completely eliminate any soil moisture stress. Harvest-to-harvest cycles intervals were longer with sprinkler irrigation than with drip. This delay was ascribed partly to a slower leaf emergence rate from sprinkler-irrigated plants. Sprinklers also delayed peak flowering from early summer to autumn, with a consequent further cycle delay due to the seasonal effect of winter bunch development. Bunch mass in the R2 was increased by 23% with drip irrigation due to more hands per bunch, more fingers per hand, and increased by 23% with drip irrigation due to more hands per bunch, more fingers per hand, and longer fingers. The shorter crop cycles and larger bunches with drip, resulting from both system and seasonal effects, increased yield per annum by 31 and 33% in the R1 and R2 cycles, respectively. Frequent irrigation with undercanopy sprinklers reduced soil and pseudostem temperatures by up to 3 C, implying that evaporative cooling was detrimental to leaf emergence rate and yield. A residual pseudostem cooling effect was also evident throughout the day, after irrigation. The implications of such temperature reductions are discussed. Under the conditions of this experiment, drip irrigation proved superior to undercanopy sprinklers for bananas, during both a drought year (R1) and a year of normal rainfall (R2) in a subtropical region. (Author's abstract)

MYCORRHIZAE, SOIL AMENDMENTS, WATER RELATIONS AND GROWTH OF ROSA MULTIFLORA UNDER REDUCED IRRIGATION REGIMES, Texas A and M Univ., College Station. Dept. of Horticultural Sciences. For primary bibliographic entry see Field 2G. W88-08376

WATERBUSTING: IRRIGATION INVEST-MENT AGGRAVATES COMMODITY SUR-PLUSES, M. L. Cotner.

Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 5, p 335-338, September-October 1987. 13 ref.

Descriptors: *Irrigation programs, *Water resources development, *Water policy, *Crop production, *Water conservation, *Public policy, *Water allocation, Waterbusting, Economic aspects, Pricing.

Many farmers are waterbusting their land, spending hundreds of thousands of dollars each year to develop and maintain irrigation capacity. This investment proceeds even though farm prices stagger under commodity surpluses and sagging demand. The expanded irrigation produces more program crops, while acreage reduction programs attempt to curb production. The result is a sizable slippage in the intended effects of commodity programs. Waterbusting is also seriously depleting the nation's groundwater resources. This paper presents potential policy prescriptions aimed at the coordination of agricultural and water policies at both the federal and state levels. The intent of the policy suggestions is to restrain new irrigation policy suggestions is to restrain new irrigation development destined for the production of surplus crops until such production is warranted. Under this policy, the federal government should deny commodity program and related benefits to farmcommodity program and related benefits to farmers growing restricted-production crops on newly developed irrigated lands. Program agencies planning irrigation projects should use price assumptions consistent with supply and demand conditions projected for the life of the projects. State governments, which grant property rights to water and federal agencies, should develop ways to permit market forces to influence water allocation. Public-financed water development projects should be restricted to those projects providing positive net returns to agriculture, and clear benefits to consumers in the form of lower priced products and services. Lastly, states should establish programs to curb depletion of water resources in a manner consistent with regional and national needs and policies. (Sand-PTT)

W88-08380

STRAW BURNING REDUCES INFILTRATION IN WINTER WHEAT, Kansas State Univ., Manhattan. Dept. of Agricul-

tural Engineering.

J. Steichen, M. Hooker, and D. M. Powell

Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 5, p 364-366, September-October 1987. 1 fig, 3 tab, 10 ref.

Descriptors: *Residue burning, *Wheat, *Rainfall, *Infiltration, *Irrigation efficiency, Crop yield, Simulated rainfall, Straw, Cultivation.

A long-term experiment was established in 1969 to determine the effects of residue burning and residue removal on irrigated winter wheat yields. After 10 years, a trend toward lower yields developed After 10 years, a trend toward lower yields developed on the burned and physical-removal plots. Rainfall simulation studies conducted on these same plots showed significantly less infiltration on the burned treatment plots than on other treatment plots during the fallow period. However, rainfall simulator data collected on the same plot about a month before wheat harvest showed no significant difference in infiltration among treatments. The difference in infiltration may or may not affect irrigated wheat yields. Reduced infiltration would be a more important factor in a dryland cronning be a more important factor in a dryland cropping system. Infiltration probably affects irrigation water efficiency more than grain yields. (Author's abstract) W88-08383

MANAGEMENT OF WATER PROJECTS: DE-CISION-MAKING AND INVESTMENT AP-PRAISAL. Organization for Economic Co-Operation and De-

velopment, Paris (France).
For primary bibliographic entry see Field 6B.
W88-08504

SEDIMENT, EROSION AND WATER INTAKE IN FURROWS

Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. For primary bibliographic entry see Field 2J. W88-08592

EFFECT OF TILLAGE AND FURROW IRRIGA-TION TIMING ON EFFICIENCY OF PRE-PLANT IRRIGATION, Clemson Univ., SC. Dept. of Agronomy and Soils. D. J. Undersander, and C. Regier. Irrigation Science IRSCD2, Vol. 9, No. 1, p 57-67, 1988. 7 tab, 17 ref.

Descriptors: *Preplant irrigation, *Sorghum, *Tillage effects, *Irrigation engineering, *Irrigation effects, Soil water, Crop yield, Agriculture, Soil compaction, Soil mechanics, Soil-water-plant relationships, Plants, Food crops, Irrigation, Texas.

A field study to determine the efficiency of pre-plant irrigating with furrow irrigation and the ef-fects of tillage and fall or spring application of preplant irrigation on this efficiency was conduct-ed during 1983, 1984, and 1985 at the Texas Agri-cultural Experiment Station, North Plains Re-search Field at Etter, Texas on a Sherm, silty clay search Field at Etter, Texas on a Sherm, silty clay loam soil. Sorghum residue from the previous crop was shredded, gravimetric soil samples were taken, and five tillage treatments were imposed in the fall. The tillage treatments consisted of various combinations of disking, chiselling, moldboard plowing, and disk bedding. A preplant irrigation was applied in the fall to half of each tillage plot and in the spring to the other half of each plot. Soil samples were taken from each plot one month after the spring to the other half of each plot. Soil samples were taken from each plot one month after the spring preplant irrigation. Sorghum (Sorghum bicolor L. ev. 'NC 178') was planted and ririgated similarly on all plots during the growing season. On the average, 237 mm of water were required to irrigate the tillage treatments during fall preplant irrigation and 466 mm were required during spring preplant irrigation. The additional water requirement in the spring was associated with increased water uptake by non-wheel-track furrows. Treat-

ments with chiselling required larger water application during spring preplant irrigation. All treatments had similar soil water contents at planting time. Neither timing of preplant irrigation nor type of tillage had any effect on sorghum grain yield. the triage and any effect on sorgnum grain yield. Therefore, fall preplant irrigation was considerably more efficient than spring preplant irrigation. Averaged over the three years of study and five tillage treatments storage efficiency was 26% for fall application and 17% for springtime. (Author's abstract) W88-08593

INTERCEPTION AND STORAGE OF SUR-FACE RUN-OFF IN PONDS IN SMALL AGRI-CULTURAL WATERSHEDS, ANDHRA PRA-DESH. INDIA.

Central Research Inst. for Dryland Agriculture, Hyderabad (India). K. P. R. Vittal, K. Vijayalakshmi, and U. M. B.

Irrigation Science IRSCD2, Vol. 9, No. 1, p 69-75, 1988. 1 fig, 3 tab, 18 ref.

Descriptors: *Runoff farming, *Runoff conserva-tion, *Agricultural watersheds, *Water storage, *Surface runoff, *Irrigation water, Surface drain-age, Catchment areas, Rainfall, Agriculture, Irriga-tion, Runoff, Seasonal variation.

A 8.93 ha graded agricultural watershed was developed with a 0.4% slope of cultivation line farming. Within this agricultural watershed, 6 ponds, each with a volume of about 180 cu m, were dug for an average catchment size of 0.91 ha which was referred to as a small watershed. This attempt to store water is the first of its kind in this region at this scale under arable conditions. It was found to store water is the first of its kind in this region at this scale under arable conditions. It was found that about 20% of the annual run-off could be retained by these ponds. With effective scalants, such as plastic lining overlaid with brick work or cement plastic lining overlaid with brick work or cement plastic lining overlaid with brick work or cement plastering on brick work, water could be retained in the ponds for longer periods to provide for the needs of crops at stress periods. Natural silting was not effective in controlling seepage in these small ponds. Despite wide variations in rainfall during the period 1976-1985, it was observed that the ponds were filled annually from run-off. In this study area increasing pond size to 300 cu m for a 1.0 ha catchment would be desirable to provide enough stored water for supplemental irrigation to enough stored water for supplemental irrigation to the cropping system. (Author's abstract) W88-08594

ECONOMIC ANALYSIS OF AGRICULTURAL NONPOINT POLLUTION CONTROL ALTER-

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.

For primary bibliographic entry see Field 5G. W88-08622

CONSERVATION TILLAGE: PERCEIVED AND ACTUAL USE, Nebraska Univ.-Lincoln.

E. C. Dickey, P. J. Jasa, B. J. Dolesh, L. A. Brown, and S. K. Rockwell.

Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 6, p 431-434, November-December 1987. 4 tab, 17 ref.

Descriptors: *Soil conservation, *Cultivated lands, *Form management, *Nebraska, *Conservation tillage, Surveys, Soil compaction, Soil mechanics,

A mail survey of farmers in Nebraska showed their A mai survey of namers in reconstance moves their perceived use of conservation tillage was about 55%. However, using the 30% residue cover criterion that the Conservation Tillage Information Center uses to define conservation tillage, a field survey of seven counties in 1984 showed that actual use of conservation tillage was less than 5%. Fewer than 20% of the producers surveyed had been than 20% certified over remaining after that rewer than 20% of the producers surveyed had more than 20% residue cover remaining after till-age and planting. The field survey also showed disk tillage systems were used by almost 70% of the producers. The modiboard plow was used by only 15% of the producers, thus creating an im-

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F-Conservation In Agriculture

pression that conservation tillage had been adopted. (Author's abstract) W88-08623

ASSESSMENT OF WATER SUPPLY FOR AGRICULTURE IN THE NIGER RIVER BASIN DEVELOPMENT AUTHORITY AREA, NIGE-

Ife Univ. (Nigeria). Dept. of Geography. For primary bibliographic entry see Field 5F. W88-08626

INFLUENCE OF DROUGHT ON STOMATAL CONDUCTANCE AND WATER POTENTIAL OF PEACH TREES GROWING IN THE FIELD, Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosocio-

Montpener (France). Centre d Educas Physiocial-logiques et Ecologiques Louis-Emberger. E. Garnier, and A. Berger. Scientia Horticulturae SHRTAH, Vol. 32, No. 3-4, p 249-263, July 1987. 6 fig. 1 tab, 53 ref.

Descriptors: *Soil-water-plant relationships, *Drought resistance, *Stomatal transpiration, *Plant water potential, *Peaches, *Evapotranspiration, Soil water, Mathematical studies, Statistical methods, Plants.

Stomatal conductance and leaf and stem water potentials were measured on peach trees irrigated at 50 and 100% of calculated maximum evapotranspiration in order to determine the influence of soil drying on these indicators of plant water stress. In addition, the relationship between stomatal con-ductance and air vapor pressure deficit was examined. Stomatal conductance and daily leaf and stem water potentials have been shown to decrease linearly with decreasing soil water content averaged over the upper 60 cm of soil. Pre-dawn water potential was insensitive to the drying of the soil over a wide range of soil water contents, and decreased sharply after a threshold value was decreased snarply after a threshold value was reached. A multiple regression analysis showed that the leaf water potential and the air vapor pressure deficit explained 49% of the stomatal conductance variance. However, our data did not allow us to show whether the influence of soil drying on stomatal conductance was direct or me-diated by the leaf water potential. (Author's abstract) W88-08627

SINGLE DECISION-MAKER APPROACH TO IRRIGATION RESERVOIR AND FARM MAN-AGEMENT DECISION MAKING, New South Wales Univ., Kensington (Australia).

School of Economics. For primary bibliographic entry see Field 6A.

VOLUME SHARING OF RESERVOIR WATER, New South Wales Univ., Kensington (Australia).

For primary bibliographic entry see Field 6A. W88-08657

PLANT POPULATION, RAINFALL, AND SOR-GHUM PRODUCTION IN BOTSWANA: I. RE-SULTS OF EXPERIMENT STATION TRIALS, Agricultural Research Station, Gaborone (Botswa na). Dryland Farming Research Scheme. M. J. Jones.

Experimental Agriculture EXAGAL, Vol. 23, p 335-347, 1987. 6 fig, 7 tab, 6 ref.

Descriptors: *Soil-water-plant relationships, *Rainfall, *Planting management, *Crop yield, *Plant populations, *Grain crops, Sorghum, Dry farming, Agriculture, Botswana, Mathematical studies, Agricultural hydrology, Hydrology, Farming, Cultivation, Crop production

General mathematical relations between yield parameters, plant populations and rainfall were developed for an indigenous sorghum from the results of 28 population/row spacing trials conducted at four sites over five seasons. Populations maximizing yield increased from 25,000 to 69,000

plants/ha over the rainfall range 200-700 mm (pre-planting to harvest total). Tillering partly compen-sated for low populations but yields from 10,000 plants/ha at 300 and 600 mm rainfall were only 80 and 61% of potential maximum, respectively. Row spacing at constant population affected tiller num-bers and eventual panicle weights but not panicle numbers, and any yield differences were related to rainfall. (See also W88-08748) (Author's abstract) W88-08747

PLANT POPULATION, RAINFALL, AND SOR-GHUM PRODUCTION IN BOTSWANA: II. DE-VELOPMENT OF FARMER RECOMMENDA-

TIONS, Agricultural Research Station, Gaborone (Botswana). Dryland Farming Research Scheme M. J. Jones.

Experimental Agriculture EXAGAL, Vol. 23, p 349-356, 1987. 2 fig, 2 tab, 2 ref.

Descriptors: *Soil-water-plant relationships, *Rainfall, *Planting management, *Crop yield, *Plant populations, *Grain crops, Sorghum, Dry farming, Agriculture, Botswana, Mathematical studies, Agricultural hydrology, Hydrology, Farming, Cultivation, Crop production, Model studies.

Regional population recommendations for sor-ghum production in Botswana were calculated by Regional population recommendations for sorghum production in Botswana were calculated by
applying long-term meteorological records to an
experimentally developed model linking sorghum
yield to plant population and rainfall. The basic
recommendation at any place was taken to be that
population maximizing local long-term yield means
while keeping the risk of crop failure to one year in
ten or less. Values ranged form 25,000 to nearly
70,000 plants/ha, according to rainfall amount and
reliability. To allow for farming realities, certain
practical amendments were made. These include
reductions in target populations to allow for subut the summan of 50% of the basic
population recommended for the district; small
increases in target population in well-managed
commercial enterprises where risk avoidance is a
less pressing consideration; and allowance for varietal differences with, all else being equal, target
populations 10-20% less than basic population figures for tall long-season varieties and up to 25%
more for short-stemmed short-season varieties. ures for fall long-season varieties and up to 25% more for short-stemmed short-season varieties. Staggering the planting date over two or three dates appears to be a safer strategy than planting early, thus avoiding the problem of greatest vegetative growth during the period of greatest evaporative demand. (See also W88-08747) (Cassar-PTT) W88-08748

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EFFECTS OF PRECIPITATION AND LAND USE ON STORM RUNOFF, Geological Survey, Lansing, MI. Water Resources

Div. For primary bibliographic entry see Field 2E. W88-08050

PUBLIC ACCEPTS STORMWATER CONTROL

PUBLIC ACCEPTS STORMANDERS AL.

BCM Engineers, Mobile, AL.

M. Steeves, and C. Chapman
Water Engineering and Management
WENDMD2, Vol. 135, No. 4, p 22-24, April 1988.

Descriptors: *Flood control, *Storm Runoff, *Management planning, *Public policy, Alabama, Flooding, Flood protection, Long-term planning, Data storage and retrieval, User charges, Public opinion, Public participation.

After four decades of putting up with the flooding problems that plagued the area, Mobile, Alabama,

one of the wettest, most flood-prone cities in the U. S., is about to get them under control. To determine what kinds of long-term improvements uetermine what kinds of long-term improvements were needed public works department records dating back to 1946 were analyzed by a consulting firm. To finance the effort, a user-fee system was proposed, whereby fees would be collected from all property owners based on the aforement. all property owners based on the stormwater runoff generated by each property. By presenting its plans for a new stormwater-management plan to the public before the formal hearing required for the puotic before the formal nearing required for the program's adoption, city managers were able to gage and respond to public concerns. The im-plementation phase now underway involves setting up a data base containing the addresses of approxi-mately 75,000 owners and properties; calculating user's fees based on an aerial survey of the proper-ties; setting up a mechanism to collect fees; and drafting a stormwater master plan and manage-ment code. Mobile was behind the times when it came to stormwater control; now it's in the fore-front as a result of a carefully-thought-out flood-management program. (Shidler-PTT) W88-08133

EVALUATING FLOOD RETARDING STRUC-

Hydrosystems Engineers, Colorado Springs, CO. For primary bibliographic entry see Field 8B. W88-08191

INFESTATION BY AQUATIC WEEDS OF THE FERN GENUS SALVINIA: ITS STATUS AND CONTROL.

Centre for Water Resources Development and Management, Kunnamangalam (India). Water Management, Kunnamangalam Quality and Environment Div. S. A. Abbasi, and P. C. Nipaney

Environmental Conservation EVCNA4, Vol. 13, No. 3, p 235-241, Autumn 1986. 4 fig, 50 ref.

Descriptors: *Aquatic weeds, *Aquatic weed control, *Water pollution, *Chemcontrol, *Biocontrol, *Mechanical control, *Biogas, *Fertilizers, *Wastewater treatment, *Biological wastewater treatment, Anaerobic digestion, Compost, Livestock feeds, Costs, Pulp and paper industry.

The growing predominance of aquatic weeds of the genus Salvinia in the waterbodies of the world is discussed. The various ways in which Salvinia molesta, particularly, causes pollution and deple-tion of water resources are reviewed, along with attempts made to control and eradicate Salvinia attempts made to control and eradicate Salvinia through chemical, biological and mechanical means. Not only have these attempts failed to achieve their purpose, but there are also possibilities of environmental backlash being caused by the introduction of chemicals or biological agents into the environment. The importance of developing environmentally safe methods of utilization of Salvinia is stressed, so that the cost of mechanical removal of the weed can be offset by the profits earned through its utilization. Attempts at utilization of Salvinia as compost, livestock feed, raw materials for paper pulp, etc. are discussed. Anaerobic conversion of Salvinia into biogas and fertilizers may be a feasible and safe method of its utilization. The method could be used in conjunction with wastewater purification schemes employing with wastewater purification schemes employing Salvinia. The studies carried out by the authors with this objective are briefly reviewed, as is their success in operating commercial digesters with Salvinia-cow dung mixtures. (Sand-PTT) W88-08214

SUCCESSFUL CONTROL OF THE FLOATING WEED SALVINIA MOLESTA IN PAPUA, NEW GUINEA: A USEFUL BIOLOGICAL INVASION NEUTRALIZES A DISASTROUS ONE,

United Nations Development Programme, Wewak (Papua New Guinea). Salvinia Control Project. P. A. Thomas, and P. R. Room.

Environmental Conservation EVCNA4, Vol. 13, No. 3, p 242-248, Autumn 1986. 6 fig, 25 ref.

Descriptors: *Aquatic insects, *Aquatic weeds, *Aquatic weed control, *Biocontrol, Salvinia mo-

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

lesta, Cyrtobagous salviniae, Insects, Water beetles, Papua New Guinea.

Salvinia molesta is a free-floating water-fern which can quickly cover freshwater lakes and slow-moving rivers with thick, floating mats which are often colonized by other vegetation to form sudd. These mats can severely impede human use of water bodies. The effects have been particularly serious in the floodplain area of the Sepik River of Papua New Guinea, where the inhabitants are totally dependent on water transport for access to markets, schools and medical facilities, and for transport of crop and fish products. This report discusses the successful biological control of Salvinia by the beetle, Cyrtobagous salviniae. This species was established in one lagoon in 1982 and over the next 2 years 900,000 adults were redistributed manually among another 130 lagoons and lakes. Local dispersal occurred when population densities reached 15 adults per kg of Salvinia, damaging between 70-90% of Salvinia buds. The time taken for the beetles to spread throughout a lagoon and for the weed to be controlled was generally 12-18 months. The herbicide Paraquat was used to aid establishment of the beetles at one site by thinning a thick mat colonized by sudd vegetation. An equilibrium was reached with Salvinia present at <1% of its former population. At its peak in 1983-84, Salvinia covered more than half of the Sepik floodplain and many lagoons were completely covered. By June 1985, the beetle had reduced the percentage of covered water surface from 54% to 0.5% by destroying 250 sq km or some 2 million tons of weed. (Sand-PTT)

DEFORESTATION AND FLOODS, For primary bibliographic entry see Field 4C. W88-08217

CONSERVATION AND UTILIZATION OF AQUATIC MACROPHYTES IN LAKE KAINJI, NIGERIA,

Kainji Lake Research Inst., New Bussa (Nigeria). For primary bibliographic entry see Field 2H.

DRAINAGE SPURS ON CUT SLOPES: PRESENTATION OF DIMENSIONING CHARTS ON HYDRAULIC AND MECHANICAL CRITERIA (LES EPERONS DRAINANTS DANS LES TALUS EN DEBLAI: PRESENTATION D'ABAGUES DE DIMENSIONNEMENT SUR CRITERES HYDRAULIQUES ET MECANIQUES), Nancy-1 Univ. (France).

P. Aigle, F. Desnouvaux, and J. P. Prost. Canadian Geotechnical Journal CGJOAH, Vol. 24, No. 4, p 590-600, November 1987. 21 fig. 1 tab, 7 ref.

Descriptors: *Furrow drainage, *Open-channel drainage, *Drainage spurs, *Drainage systems, Soil mechanics, Engineering, Slope stability, Model studies, Analog models, Dimensioning chart.

Design charts are presented that facilitate the design of a series of parallel drainage spurs in association with a drainage ditch used in cut slopes. The hypotheses, the operating instructions, and the field of utilization are fully detailed. The two necessary dimensions are the depth and spacing of the drainage spurs. The design charts are of two main types. Simple dimensioning charts include information on possible combinations of depth and spacing, providing quantitative aspects, such as lowering the level of the water table or increasing the safety factor. Optimization charts include estimations of the solution that minimizes the depth of the spurs per linear meter of slope, the depth of the spurs per linear meter of slope, and subsequently the volume of the draining material. These results were produced from theoretical and experimental research carried out over several years. A composite analog model that simulates free-surface three-dimensional flows also was used. (Author's abstract)

ANALYSIS OF INTERCEPTOR DITCHES FOR CONTROL OF GROUNDWATER POLLUTION, Wisconsin Univ.-Madison. Dept. of Geology and For primary bibliographic entry see Field 5G. W88-08328

USE OF RORB AND SWMM MODELS TO AN URBAN CATCHMENT IN SINGAPORE, National Univ. of Singapore. Dept. of Civil Engineering. S. Selvalingam, S. Y. Liong, and P. C. Manoharan. Advances in Water Resources AWREDI, Vol. 10, No. 2, p 78-86, June 1987. 8 fig, 4 tab, 5 ref.

Descriptors: *Urban drainage, *Storm runoff, *Catchment areas, *Floods, *Urban hydrology, *Urban runoff, *Runoff, *RORB model, *Urbanization, Simulation analysis, Singapore.

The Runoff Routing Model (RORB) and the Storm Water Management Model (SWMM) are evaluated for the purpose of stormwater drainage and management in an urban catchment in Singapore although the full capacity of the SWMM model has not been utilized. Data preparation for testing the models are highlighted and sample runs are carried out for an actual storm event. Limitations and constraints of the parameter estimation are discussed. Comparison of the runoff results are made between RORB and SWMM models. Both models can be incorporated without much difficulty to simulate urban drainage system in Singapore. (Author's abstract) W88-08343

FLOODS ON EAST FORK MULBERRY CREEK AND PRICE BRANCH IN THE VICINITY OF LYNCHBURG, TENNESSEE.
Tennessee Valley Authority, Knoxville. Office of Natural Resources and Economic Development. Available from the National Technical Information Service, Springfield, VA 22161, as DE87-900851. Price codes: AO4 in paper copy, AO1 in microfiche. TVA Flood Report No. TVA/ONRED/AWR-87/6, November 1986. 50 p, 1 fig, 6 tab, 3 ref, 7 plates.

Descriptors: *Streamflow, *Tennessee, *Floods, East Fork Mulberry Creek, Lynchburg, Channel flow, Flooding, Flood basins.

Described here is the flood situation along East Fork Mulberry Creek, Tennessee, from stream mile 5.99 to stream mile 15.46, and Price Branch from stream mile 0.00 to stream mile 1.90. This flood hazard information report describes the extent and severity of the possible flooding along selected reaches of those streams listed above for selected reaches of those streams listed above for watershed and channel conditions as of March 1986. Detailed information is provided concerning the current flood threat along the studied stream reaches. The report does not propose plans for the solution of identified flood problems. Rather, it provides the flood information needed to make informed decisions regarding the use of flood-prone lands within the study area. (Lantz-PTT) wegnator. prone lands W88-08393

EASTERN SUBBASIN LOW FLOW MANAGE-MENT FRAMEWORK PLAN, Susquehanna River Basin Commission, Harrisburg,

D. W. Heicher, and G. H. Hirschel. Susquehanna River Basin Commission, Harrisburg, PA. Publication No. 117, April 1988. 186 p, 15 fig, 64 tab, 37 ref, 6 append.

Descriptors: *Flow control, *Management planning, *Watersheds, *Hydrologic budget, *Water use, *Streamflow, *Low flow, Irrigation, Drought, Flow profiles, Water management, Water deficit.

This report uses the Q7-10 (7-day, 10 year low flow) value as a target for comparison of potential water deficits within watersheds during a defined frequency low flow event. In general, upstream consumption was found to be small in comparison to the Q7-10 value at the mouths of major stream sections in the subbasin. Total consumptive use in

the subbasin during theoretical 1980 low flow the subbasin during theoretical 1980 low flow conditions was estimated to be about 38.88 MGD (60.16 cfs). Consumptive use during potential low flow conditions in the year 2000 was projected to be about 40.76 MGD (63.07 cfs). Irrigation can aware count for nearly half of the total amount of water consumed during potential low flow conditions in the Eastern Subbasin. The extent of irrigation operations varies with the time of year, market conditions, and other factors. No reliable system currently exists for monitoring irrigation with conditions, and other factors. No reliable system currently exists for monitoring irrigation withdrawals during actual low flow events. If meteorological conditions producing the 1964 drought habeen repeated in 1980, it is estimated that 15,365 acre feet of water would have been required to maintain Q7-10 flows at the mouth of the Eastern mantain (7-10 nows at the mouth of the Eastern Subbasin. About 15,967 acre feet would be re-quired if the 1964 drought were to be repeated in the year 2000. Potential water deficits have been identified at the outlets of all major stream sections identified at the outlets of all major stream sections in the subbasin, based on maintenance of the Q7-10. Further study is required to establish targets for low flow management in the Eastern Subbasin. A more thorough knowledge of minimum instream flow requirements, as well as the fresh water requirements of the Chesapeake Bay are required to establish definitive low flow goals at key locations in the subbasin. (Lantz-PTT) W88-08395

WATER RESOURCES: DISTRIBUTION, USE, AND MANAGEMENT,

Delaware Univ., Newark. Dept. of Geography. For primary bibliographic entry see Field 6B. W88-08421

FAULT-TOLERANT DESIGN FOR DATA ACQUISITION AND FLOOD FORECAST SYSTEMS,

Sierra-Misco, Inc., Sacramento, CA. D. C. Curtis.

Public Works PUWOAH, Vol. 119, No. 4, p 38-40, April 1988. 3 fig, 1 tab.

Descriptors: *Telemetry, *Automation, *Flood control, *Flood forecasting, *Floods, *Passaic River, Rivers, Data acquisition, Rain gages, River basins, Satellite technology, Runoff.

The design and implementation of the Passaic River (New Jersey) Basin Flood Warning System is described. Thirty-one rain gauges, including 23 new event-reporting gages and the automation of eight existing Fisher-Porter gages, were specified for the Passaic Basin. Data from the gauge network were required at ten computerized receiving sites. The receiving sites also passed text messages, including National Weather Service forecasts, and warnings, and administrative inforincluding National Weather Service forecasts, watches, and warnings, and administrative information. VHF and satellite communications technology were used in developing the system. The system is designed to automatically tolerate the failure of major components without disrupting key elements of the flood warning system. (Roseman-PTD) W88-08548

POPULATION DYNAMICS OF DUCKWEED COVER IN POLDER DITCHES,

Leiden Rijksuniversiteit (Netherlands). Centre for Environmental Studies. For primary bibliographic entry see Field 5C. W88-08598

FIELD DRAINAGE, SOIL WATER MANAGE-MENT AND FLOOD HAZARD.

Seale-Hayne Coll., Newton Abbot (England). R. Parkinson, and I. Reid. Soil Use and Management, Vol. 3, No. 4, p 133-138, December 1987. 5 fig, 2 tab, 14 ref.

Descriptors: *Tile drainage, *Surface drainage, *Surface runoff, Rainfall-runoff relationships, Catchment areas, Drainage engineering, Soil properties, Storms, Rainfall, Runoff, Agricultural runoff, Flood hydrographs, Soil water.

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A-Control Of Water On The Surface

The efficient management of clay soils depends on the rapid disposal of water following rainfall. Winter storm outfall hydrographs of underdrained Winter storm outfall hydrographs of underdrained catchments ranging in size from 0.44 ha to 7.2 sq km are given, illustrating the drainage response of a Windsor Series soil. The response time of different sized catchments is discussed in relation to potential flood hazard arising from drainage improvements of agricultural land. Comparison is made with other soils to reveal broadly similar patterns of drainflow, with peak flow occurring typically between 1 and 4 hours after the mid-point of a storm. Desnite large fluxes of water through of a storm. Despite large fluxes of water through the soil profile, the water content of the soil within the catchment of an individual tile lateral is shown to vary only by small amounts both during and after a single rainstorm and over a drainage season. (Author's abstract)

INTERBASIN WATER DIVERSIONS: A CANA-DIAN PERSPECTIVE,

Inland Waters Directorate, Ottawa (Ontario).

Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 6, p 389-393, November-December 1987, 13 ref.

Descriptors: *Water demand, *Diversion, *Canada, *Interbasin transfer, *Legal aspects, *Political aspects, Drainage systems, Catchment areas, Hydroelectric power, Economic aspects, Water resources development, United States.

There are several findings apparent from a review of Canadian water diversion trends: Most diversions use shortcuts and natural channels to advanstons use subtreuts and natural channels to advan-tage in reordering the dense and disorganized drainage of a heavily glaciated landscape. Interba-sin diversions are numerous. Some are long-estab-lished, and those most recent are massive in scale, raising diversion totals to a magnitude unknown in any other country. Diversions are scattered widely any other country. Diversions are scattered widely across the country, most of them remote from more populated regions. Hydroelectric power ('hydro') is the dominate use. Most projects have been developed by provincial corporations whose principal objective has been to maximize low-cost power, not water, to southern markets. Little attention was given to social or environmental conditions by project developers before the mid 1970s, when native peoples directly affected, as well as environmental organizations began to insist on a better deal. Planners still have a great deal to learn environmental organizations began to insist on a better deal. Planners still have a great deal to learn about projecting future needs and implications. The existing pattern of interbasin diversions in Canada is unlikely to change significantly in the next few years, partly because of surplus hydro capacity and the potential for more hydro without capacity and the potential for more hydrox without more diversions and partly because rising prices for water should encourage conservation and greater efficiency by users. All of these findings paint a picture of Canadian-style water diversion that is quite different from that found in other countries or anticipated by promoters of continential water schemes. To be more specific cristing tal water schemes. To be more specific, existing Canadian transfers do not have a north-south orientation, do not divert water from better watered entation, do not divert water from better watered to drier regions, and do not divert water from less-populated to more-populated regions. Neither have they been attended by interjurisdictional conflict. The pattern to date is uniquely Canadian, not the first stages of a pipeline leading south of the border. (Alexander-PTT) W88-08619

VOLUME SHARING OF RESERVOIR WATER, New South Wales Univ., Kensington (Australia). School of Economics. For primary bibliographic entry see Field 6A. W88-08657

4B. Groundwater Management

ALGORITHM FOR THE CALCULATION OF DRAIN SPACINGS FOR LAYERED SOILS, Polish Academy of Sciences, Lublin, Inst. Agrofizyki. For primary bibliographic entry see Field 2G.

W88-07987

PRIVATIZING THE GROUND WATER RE-SOURCE: INDIVIDUAL USE AND ALTERNA-California State Univ.-Northridge. Dept. of Eco-

For primary bibliographic entry see Field 6E. W88-08048

VERIFICATION OF A MODEL PREDICTING SEDIMENT LEVEL IN SUBSURFACE DRAINS, Laval Univ., Quebec. Dept. of Soil Science. For primary bibliographic entry see Field 2J. W88-08055

SIMULATING SUBSURFACE DRAINAGE IN THE LOWER MISSISSIPPI VALLEY WITH DRAINMOD.

DRAINMOD, Agricultural Research Service, Baton Rouge, LA. Soil and Water Pollution Research Unit. J. L. Fouss, R. L. Bengtson, and C. E. Carter. American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1679-1688, November-December 1987. 8 fig, 10 tab, 32 ref.

Descriptors: *Erosion, *Sediments, *Runoff, *DRAINMOD, *Subsurface drains, *Soil erosion, *Water table gradient, *Rainfall-runoff relationships, *Model studies, Prediction, Mathematical studies, Simulation, Soil water, Evapotranspiration, Mathematical models, Mississippi Valley,

Mathematical models.

Data from a subsurface drainage-runoff-erosion field experiment near Baton Rouge, LA, were used to evaluate the water management model, DRAINMOD, for simulating subsurface drainage in the lower Mississippi Valley. Predicted and measured surface runoff, subsurface drain flow, and water table depth were compared for 3 years, 1981, 1982 and 1983 which were, respectively, normal-to-wet, drier than normal, and very wet in growing season soil water conditions. Model predicted runoff, drain flow, and water table depth compared more closely with the field measured (observed) values during the wettest year, 1983. For the drier-than-normal year, 1982, runoff and drain flow were significantly overpredicted because evapotranspiration (ET) was underestimated by the model. Assumed deeper rooting for corn in 1982 increased soil water withdrawal by ET and significantly improved predictions of water table depth. (Author's abstract)

GROUNDWATER RECHARGE PLANNING USING RESOLVENT DISCRETE KERNELS, Arkansas Univ., Fayetteville. Dept. of Agricultural For primary bibliographic entry see Field 2F.

TWO-STAGE WEIR CONTROL OF SUBSUR-FACE DRAINAGE FOR WATER TABLE MAN-

AGEMENT,
Agricultural Research Service, Baton Rouge, LA.
Soil and Water Pollution Research Unit. For primary bibliographic entry see Field 3F. W88-08064

BOUNDARY ELEMENT APPROACH FOR MODELLING GROUNDWATER MOVEMENT, Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopolous

Advances in Water Resources AWREDI, Vol. 9, No. 3, p 171-177, September 1986. 6 fig, 12 ref.

Descriptors: *Mathematical models, *Hydrologic models, *Groundwater movement, *Groundwater management, *Groundwater pollution, *Geothermal resources, Aquifers, Pump wells, Recharge

Pumping and recharging water through wells are among the most significant activities in the man-

agement of groundwater resources. This leads to the need of numerical models for the simulation of the need of numerical models for the simulation of the groundwater movement in aquifers, with an emphasis placed upon the accurate estimation of the flow near wells. Boundary element methods can easily cope with singularities, like sources and sinks, whereas the domain methods require com-plex procedures for their modeling. A simple and efficient boundary element technique leading to a straightforward calculation of groundwater veloci-ties, and consequently of streamlines, travel times, and breakthrough curves, is presented. The pro-posed numerical algorithm applies to problems dealing with groundwater contamination and geo-thermal resources exploitation. (Author's abstract) W88-08182 W88-08185

COUPLING OF FINITE ELEMENT AND OPTI-MIZATION METHODS FOR THE MANAGE-MENT OF GROUNDWATER SYSTEMS, Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hy-

dromechanik.

B. Herrling, and A. Heckele. Advances in Water Resources AWREDI, Vol. 9, No. 4, p 190-195, December 1986. 2 fig, 15 ref.

Descriptors: *Groundwater management, *Mathematical models, *Pump wells, *Groundwater movement, Hydrologic models, Finite element ethod, Optio ization method.

An optimization method for the solution of groundwater management problems is described. The method consists of a combination of the computation of horizontal plane groundwater flow with a free surface (finite element method) and a linear optimization procedure (simplex algorithm). Considering the special structure of data which result from computing the groundwater flow with the finite element method, and modifying the simplex algorithm, the solution of management problems with complex groundwater flow was realized without any difficulties. Compared to a flow computation alone the additional effort of the optimization (computer time and scope for data storage) is only small. (Author's abstract)

SOLUTE TRANSPORT SIMULATION OF AQ-UIFER RESTORATION AFTER IN SITU URA-NIUM MINING,

Idaho Univ., Moscow. Coll. of Mines and Earth Resources.

J. L. Osiensky, K. A. Peterson, and R. E. Williams. Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 137-144, Spring 1988. 8 fig. 3 tab, 7

Descriptors: *Aquifer management, *Aquifer restoration, *Groundwater pollution, *Uranium, *Mining, *Model studies, *Path of pollutants, Soil contamination, Water quality, Monitoring, Restoration method, Mathematical models, Simulation analysis, Wyoming, Wells, Aquifers.

In situ mining of uranium was conducted in two well fields at a research and development site in the Powder River Basin of Wyoming from March 1980 to July 1981. Subsequent aquifer restoration activities continued until December 1982. During oto July 19-13. Subsequent aquiter restoration activities continued until December 1982. During the restoration phases of operation, complex pumping-injection schemes, necessitated by the absence of adequate disposal facilities, were employed by the mining company in an attempt to satisfy the conditions imposed by the mine permit. An analytical Random Walk solute transport model was used to simulate mass transport mechanisms associated with the pumping-injection schemes used in the A-I well field. Because the hydrogeology at the site is relatively simple, a more sophisticated model requiring extensive calibration was not required. The model was not used as a predictive tool, but as an analytical supplement to existing water quality and hydrogeologic data. As such, it provided a very useful and inexpensive means by which to evaluate the adequacy of the restoration techniques employed at the site and the effectiveness of the water quality monitoring program. Model simulations suggest that the restoration methods used by the mining company were not adequate to remove residual lixiviant and actually tended to displace contaminants to a circular region between the well field and peripheral monitoring wells. An analysis of the water quality and operational history at the site suggests that the model results may be accurate. If this is true, the postrestoration water quality data collected at the site may not be an accurate measure of the effectiveness of aquifer restoration. (Author's abstract) (Author's abstract) W88-08318

FORECASTING GROUNDWATER SUITABIL-ITY FOR IRRIGATION: A CASE STUDY IN THE NILE VALLEY, EGYPT, Vrije Univ., Amsterdam (Netherlands). Inst. voor

F. Radstake, F. A. R. Attia, and A. B. M.

Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 103-119, March 15 1988. 6 fig, 4 tab, 9 ref.

Descriptors: *Water quality, *Available water, *Groundwater irrigation, *Nile Valley, *Irrigation, *Forecasting, Chemical properties, Soil type, Aquifer, Weathering, Evapotranspiration, Minerals, Salts, Sulfates, Nitrates, Egypt, Subsurface drainage, Surface water, Dissolved solids.

Methods for forecasting the suitability of pumped groundwater for irrigation in the Nile Valley, Egypt are applicable to non-consolidated semi-confined aquifers. In the Minya pilot area the chemical composition of the groundwater can be traced back to surface water from the river Nile. River Nile water is transported through a network of irrigation canals and subsequently used as irrigation water on agricultural lands. The groundwater in the aquifer consists predominantly of subsurface drainage water and of seepage water from the surface water system. The major change in chemical composition of the irrigation water occurs in the soil during the concentration of salts by evaporarspiration. The main hydrochemical reactions are calcite precipitation, cation exchange, weatherare calcite precipitation, cation exchange, weather-ing of clay minerals and reduction of sulfates and are calcite precipitation, cation exchange, weathering of clay minerals and reduction of sulfates and nitrates. A well field will be implemented with a maximum capacity of 16 600 000 cu m/yr. Pumped groundwater will then be the only source of irrigation water in the pilot area. The pumped groundwater will be a mixture of subsurface drainage water from irrigated lands inside the pilot area and of groundwater flowing across the boundaries of the pilot area. A 100 yr forecast of the water quality shows that the Total Dissolved Solids and the Sodium Adsorption Ratio for the pumped groundwater will increase from 530 to about 700 ppm and from 4 to 6, respectively. (Author's abstract) stract) W88-08330

WATER TABLE DRAWDOWN FOR TWO-DI-MENSIONAL DRAINAGE, Thessaloniki Univ., Salonika (Greece). Dept. of

Rural Engineering.
C. Tzimopoulos, and M. Sakellariou-Makrantonaki.

Advances in Water Resources AWREDI, Vol. 10, No. 3, p 159-163, September 1987. 10 fig, 6 ref.

Descriptors: *Groundwater management, *Subsurface drainage, *Drainage systems, *Water table, *Drawdown, Mathematical analysis, Boussinesq equation, Finite element method.

An analytical solution is presented for a drainage system of rectangular arrangement. The flow is assumed to be steady and the main equation used is assumed to be steady and the main equation used is the Boussinesq equation. The solution is given by a series expansion, and nondimensional charts of equipotential lines are presented. For practical application there is also given a simple algebraic expression giving the draw-down water table in the center of the rectangular arrangement. A finite element solution is also presented for comparison with the analytical solution. (Author's abstract) W88-08349

GROUND-WATER FLOW MODEL OF THE CORNING AREA, NEW YORK, Susquehanna River Basin Commission, Harrisburg,

PA. For primary bibliographic entry see Field 2F. W88-08396

GROUND-WATER RESOURCES OF THE CHEMUNG RIVER BASIN, NEW YORK AND PENNSYLVANIA,

Susquehanna River Basin Commission, Harrisburg.

Susquehanna River Basin Commission, Harrisburg, PA. Publication No. 115, March 1988. 226 p, 22 fig, 26 tab, 55 ref, append.

Descriptors: *Groundwater resources, *Ground-water budget, Chemung River, New York, Penn-sylvania, River basins, Groundwater recharge, Evapotranspiration, Streamflow, Aquifers, Groundwater reservoirs, Bedrock.

The Chemung River Basin has adequate water resources as a result of receiving an average of 34 inches of annual precipitation. Evapotranspiration is relatively high (about 20 inches), resulting in the lowest annual streamflow of any major subbasin within the Susquehanna River Basin (approximately 14 inches). About 57% of streamflow is comprised of groundwater (baseflow). Locally, groundwater withdrawals were nearly equal to the average annual recharge. These local areas containing large withdrawals have the potential for streamflow reduction and loss in aquifer yields during extended dry periods. The aquifers in the basin consist of nearly flat-lying sedimentary rocks and unconsolidated sand and gravel. Sandstone aquifers, located in upland areas in the south, have the greatest potential of the bedrock aquifers for the development of large groundwater supplies. They are little utilized, however, because of their topographic position. The predominantly shale and The Chemung River Basin has adequate water They are little utilized, however, because of their topographic position. The predominantly shale and siltstone aquifers that underlie the remainder of the basin yield enough water to wells to provide for small supplies (domestic or small farm use). The most important aquifers in the region are comprised of sand and gravel deposits of glacial origin. The median reported well yield from these deposits, collectively called stratified drift, is 13 gal/min for domestic wells and 300 gal/min for municipal for domestic wells and 300 gal/min for municipal and industrial wells. The stratified-drift aquifers are considerably more susceptible to pollution than the bedrock units. Major types and sources of ground-water contamination in the basin consist of bacte-rial organisms and nitrates from on-lot sewage systems, nitrates and pesticides from agricultural activities, organic compounds from buried hydro-carbon storage tanks and industrial processes, leachate from landfills, and acid mine drainage. (Lantz-PTT) W88-08397

FIELD DRAINAGE, SOIL WATER MANAGE-MENT AND FLOOD HAZARD,

Seale-Hayne Coll., Newton Abbot (England). For primary bibliographic entry see Field 4A. W88-08599

MOTION OF COASTAL CONFINED GROUND-WATER IN THE PRESENCE OF VARIOUS PATTERNS OF PUMPING: IL NUMERICAL ANALYSIS BY THE STEADY STATE DISPER-SION MODEL, (IN JAPANESE), Ehime Univ., Matsuyama (Japan). Dept. of Ocean

For primary bibliographic entry see Field 2F.

GROUNDWATER MODELING: A PRACTICAL APPLICATION FOR GROUNDWATER MAN-AGEMENT,

Buchart-Horn, Inc., York, PA.
For primary bibliographic entry see Field 5G.
W88-08904

UNACCOUNTED-FOR WATER - A GROUND-WATER RESOURCE (L'EAU NON COMPATI-BILISEE - UNE SOURCE D'EAUX SOUTER-

mingham Univ. (England). Dept. of Geological

Sciences. D. Lerner. Aqua AQUAAA, No. 1, p 33-42, January 1988. 6 fig, 9 tab, 33 ref, 2 append.

Descriptors: *Groundwater, *Recharge, *Soil water, *Leakage, *Groundwater recharge, *Groundwater movement, *Urban areas, *Groundwater level, Hong Kong, Lima, Sewer systems, Birmingham, Doha, Qatar, Peru, England.

The destination of unaccounted-for water and the amount of recharge to groundwater that occurs in cities is considered. Although some unaccountedfor water may be collected by sewers and some used by trees, it is probable that most becomes used by trees, it is proposed that most becomes recharge where soils are permeable. Groundwater evidence from Hong Kong and Lima, are presented in support. The contribution made by leakage from mains to the problem of rising groundwater also is considered for Doha, Qatar, and Birmigham, England. For the four cases discussed, urban recharges at least to the contribution of the contrib recharge is at least as large as recharge to an undeveloped aquifer. Direct recharge by rainfall will be less in urban areas than in open country unless soakaways are used to dispose of storm unless soakaways are used to dispose of storm water or storm sewers leak. It is not clear whether sewers leak significant amounts of water, although there are certainly instances of pollution from sewer leakage. Rising groundwater in cities can be caused by either increasing recharge or diminishing abstraction. In Birmingham, leakage has kept potential recharge at about the predevelopment quantity. There has been a large drop in abstraction which is the primary cause of rising groundwater levels. (Author's abstract)

W88-08924

4C. Effects On Water Of Man's Non-Water Activities

INFILTRATION AND WATER QUALITY ON RANGE SITES AT FORT STANTON, NEW MEXICO,

New Mexico State Univ., Las Cruces. Dept. of

Animal and Range Sciences.

J. C. Wood, and M. K. Wood.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 317-323, April 1988. 3 tab, 33 ref.

Descriptors: "Soil-water-plant-relationships, *Grazing, *Infiltration, *Water quality, Hydrology, Simulated rainfall, Infiltration rate, Fertilizers, New Mexico, Sediments, Fort Stanton, Grasslands, Pine trees, Juniper trees, Livestock.

The hydrologic impacts of livestock grazing schemes on selected plant communities and soils at Fort Stanton, New Mexico, were evaluated. Simulated rainfall was applied to 1 sq m plots. On a mesa-top, infiltration rates for a grassland livestock enclosure and a pinyon pine-juniper community closely approximated each other and were signifi-cantly greater (P = 0.10) than either a moderate cantly greater (P = 0.10) than either a moderate continuous or a heavy continuous treatment in a grassland community. Sediment concentration from the heavy continuous treatment was more than twice that of the other treatments. Infiltration rates on the hillside site were highest in a pinyon pine-juniper community receiving short duration grazing. Infiltration for this treatment was found to be significantly higher (P = 0.10) than that of a short duration grazing treatment, but not from a rest rotation grazing treatment on grassland. The short duration grazing treatment on a grassland had the highest sediment concentration, while the rest rotation grazing on a grassland and the short duration pinyon pine-juniper treatments were duration pinyon pine-juniper treatments were found to be similar. In the bottomland site, a fertilized and unfertilized treatment showed no sig-nificant difference in infiltration or sediment concentration, although twice as many animals were present on the fertilized treatment. (Author's abstract) W88-08038

MICROBIAL ACTIVITY ASSOCIATED WITH SESTON IN HEADWATER STREAMS: EF-

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4C-Effects On Water Of Man's Non-Water Activities

FECTS OF NITROGEN, PHOSPHORUS AND

TEMPERATURE, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology. For primary bibliographic entry see Field 2H.

DEFORESTATION AND FLOODS,

C. Clark.

Environmental Conservation EVCNA4, Vol. 14, No. 1, p 67-69, Spring 1987. 6 fig, 1 tab, 8 ref.

Descriptors: *Floods, *Flood control, *Forests, *Catchment basins, England, Rainfall, Flood frequency, Land use, Comparison studies, Hydraulic conductivity. Interception.

The literature on the effects of changes in land-use on river flow includes studies that have either consisted of a pair of adjacent catchments which have had their streamflow measured for about a year and then in one of the catchments the forest cover was removed before a further period of measurement, or else a single catchment was studmeasurement, or else a single catchment was stud-ied during which time the trees were either re-moved or allowed to regenerate. An experiment on one catchment may not be sufficient to assess the effect of a particular change of land-use. Further-more, the rainfall intensity must be studied both before and after the changes in land-use take place. One way to avoid these and other methodological such less it is have a sample of activement which problems is to have a sample of catchments which, apart from their forest cover, are in all other respects identical. A number of such catchment areas in East Somerset and North Dorset, England, were investigated. More than 20 basins with an average area of 0.15 sq km, all on Forest Marble, average area of 0.13 sq km, an on rorest Marole, were studied. The hypothesis that an increase in the forest cover would reduce the bankfull discharge was confirmed. There is an 11-fold difference in bankfull flow over the whole range of forest cover. Data on interception and hydraulic conductivity were then used, together with local spirafull data to roredict the needs discharge of the conductivity were tien used, together with focal rainfall data, to predict the peak discharge of the catchments. As the intensity of the rainfall increased, the difference in peak flow between the completely forested and pasture catchments decreased until, at about the 200-yr event, the difference would be likely to be minimal. However, for creased until, at about the 200-yr event, the differ-ence would be likely to be minimal. However, for the flood which may occur on average once every 50 yr, there is still a 5-fold difference in discharges. If the forest cover were completely removed, within a few years the channel would be unable to adjust to the rapid increase in flood discharge and the water level would be considerably higher than before. As the catchments covered largely by pasoctore. As the calciments covered targety by pas-ture have bigger channels than their forested coun-terparts, it would appear that these channels have become adjusted to the new flood discharges. However, flood stages or depths would still remain higher than before. (Sand-PTT) W88-08217

INDUSTRIAL DEVELOPMENT EFFECTS ON THE ECOLOGY OF A PACIFIC MEXICAN ES-

THE ECOLOGY OF A PACIFIC MEAICAN ESTUARY,
Centro de Investigacion Científica y de Educacion
Superior de Ensenada (Mexico).
S. E. Ibarra-Obando, and A. Escofet.
Environmental Conservation EVCNA4, Vol. 14,
No. 2, p 13:141, Summer 1987. 6 fig. 4 tab, 23 ref.
CONACyT Research Grant PCECBNA-021264.

Descriptors: *Water currents, *Land use, *Estuarine environment, *Salt marshes, Oil industry, Ecological effects, Environmental effects, Vegetation, Mud flats, Dikes, Fish, Birds, Punta Banda estuary, Mexico, Offshore platforms, Moisture availability, Lagoons.

In November 1983, the construction of the first part of an assembling plant of jackets to support oil-drilling platforms began at Punta Banda estu-arty, a 16.40-eq km coastal estuary located 150 km south of the USA-Mexico border. The area that is being built on (0.45 sq km) is located at the south-west corner of the estuary and is delimited by a dike. The second part of the construction, cover-ing a further 0.40 sq km, will extend to the southeast and will require some deflection of the main circulation channel. The response of the salt-marsh

vegetation to tidal suppression inside the dike (disappearance of Cordgrass, as well as of annual and short-lived middle-marsh species) is crucial to an understanding of what might happen to other portions of the marsh when the moisture regime is changed. The detour of the main circulation chanchanged. The detour of the main circulation chan-nel will introduce major modifications of tidal regime and topography, which are the structural bases for the functioning of marshes and mud-flats located at the head of the lagoon. The area eventu-ally impacted will exceed that of the construction itself, and will result in a net loss of habitat of about 8 sq km, adversely affecting fish breeding and bird populations. (Sand-PTT) W88-08219

WATER-RELATED LIMITATIONS TO LOCAL DEVELOPMENT, Swedish Natural Science Research Council, Stockholm.

M. Falkenmark, A. K. Biswas, H. Hori, T. Ishibashi, and G. Kovacs.
AMBIO AMBOCX, Vol. 16, No. 4, p 191-200,

1987. 3 fig, 2 ref.

Descriptors: "Water management, "Water shortage, "Economic development, "Costs, "Water resources development, "Land use, "Water law, Water pollution, Wastewater treatment, Water cycle, International waters, Legal aspects, Policy making, Decision making, Negotiations.

Seven international water experts were asked to discuss certain fundamental water-management problems. It was agreed that water shortage is a problems. It was agreed that water shortage is a medium-term constraint requiring attention when deciding on policies for economic development within the resource base. Wise policies include best use of local rain, a top level national water authority, and transport of food rather than water. Point disposal of toxic wastes should be considered a deliberate illegal act. Since treatment technology is generally available, the main problem is unwillingness to bear the cost. Water pollution originating from land use is best met by merging land-use and ness to bear the cost. Water pollution originating from land use is best met by merging land-use and water-management policies. The present tendency to meet growing domestic or international water disputes is by negotiation rather than by confrontation. Critical to the problems discussed is to ensure that decision makers and the general public have an adequate understanding of mankind's long-term dependence on life-supporting systems, and of the fundamental role of the water cycle in these systems. (Author's abstract) tems. (Author's abstract)

SNOWMELT RUNOFF IN SUBURBAN ENVI-RONMENTS

Trent Univ., Peterborough (Ontario). Dept. of Ge-

ography.
J. M. Buttle, and F. Xu.
Nordic Hydrology NOHYBB, Vol. 19, No. 1, p
19-40, 1988. 7 fig, 5 tab, 34 ref.

Descriptors: *Urban hydrology, *Runoff, *Suburban areas, *Snowmelt, Precipitation, Watershed, Hydrology, Snow accumulation, Microclimate, Net radiation, Permeability, Stream discharge, Rural basin, Urban area, Comparison studies, Canada, Infiltration, Seasonal variation.

While snowmelt and rain-on-snow events have re-While snowmelt and rain-on-snow events have re-ceived considerable attention in rural watersheds they have been largely ignored in urban hydrolo-gy, despite the fact that they may result in severe flooding. The runoff responses of two subcatch-ments of a small drainage basin in Petersborough, Ontario were investigated for the spring snowmelts of 1984 and 1985. One of the catchments has undergone substantial suburbanization, while the other is largely in rural land use. Measurements in each catchment included snownack water-equivacatchment included snowpack water-equivalent depths, snowmelt and precipitation, fluxes of net radiation over snowpacks, infiltration capac-ities of pervious surface types, and stream flow. Suburban development appears to have produced substantial increases in spring quickflow yields from the entire basin. A comparison of the re-sponses of the two subcatchments reveals that the suburban catchment reacts more rapidly to snow-melt and rain-on-snow inputs and generates larger

initial quickflow response ratios than the rural basin as a result of the microclimatic, pedologic and hydraulic characteristics of built-up areas. However, the dynamic behavior of the runoff con-tributing area of the rural catchment results in a tributing area of the rural cateriment results in a marked increase in its quickflow yield as melt progresses. The results suggest that the distinct nature of the processes of snow accumulation, melt and runoff generation in built-up areas should be considered when modelling suburban snowmelt runoft. (Author's abstract)

RATIONAL FORMULA INTERPRETED USING A PHYSICALLY-BASED MATHEMATI-CAL MODEL, Old Dominion Univ., Norfolk, VA.

For primary bibliographic entry see Field 2A. W88-08293

TEMPORAL, SPATIAL AND SIZE VARIATION IN THE SEDIMENT TRANSPORT IN THE KRISHNA RIVER BASIN, INDIA, Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences. For primary bibliographic entry see Field 2J. W88-08327

USE OF RORB AND SWMM MODELS TO AN URBAN CATCHMENT IN SINGAPORE, National Univ. of Singapore. Dept. of Civil Engineering.

For primary bibliographic entry see Field 4A. W88-08343

ANALYSIS OF OBJECTIVE FUNCTIONS USED IN URBAN RUNOFF MODELS,

Purdue Univ., Lafayette, IN. School of Civil Engi-

A. R. Rao, and J. Han. Advances in Water Resources AWREDI, Vol. 10, No. 4, p 205-211, December 1987. 1 fig, 7 tab, 21

Descriptors: *Urban hydrology, *Urban runoff, *Urban watersheds, *Rainfall-runoff relationships, Mathematical models, Comparison studies, Least

The objective functions used in parameter estima-tion in urban runoff models are compared by using a method proposed by Diskin and Simon and the urban runoff model ILLUDAS. Two sets of objective functions, the first one used by Diskin and Simon and a second one which includes other objective functions are used. Rainfall-runoff data from urban watersheds in the United Sates are used in the study. The results indicate that the least squares criterion is the best among those studied. (Author's abstract) W88-08354

ENVIRONMENTAL EFFECTS OF ELECTRICI-TY GENERATION.

Organization for Economic Co-Operation and Development, Paris (France).
Organization for Economic Co-Operation and Development, Paris, France. 1985. 154 p.

Descriptors: *Environmental effects, *Electric power production, *Electric powerplants, Water pollution prevention, Radioactive wastes, Costs, Economic aspects, Coal, Fuel.

This report identifies the main environmental residuals and impacts from a number of electricity generation fuel cycles, and attempts to quantify generation tuel cycles, and attempts to quantify and compare these impacts and residuals where feasible. The evaluation has been extended to cover the risks and potential impacts of abnormal occurrences. Under normal operating conditions, the main environmental residuals from a nuclear power plant are waste heat and the radioactive waste products it produces (including those of the mining and processing of the fuel) and the main issue is their long term management. In the case of a fossil fuel plant, the main environmental residuals

Identification Of Pollutants-Group 5A

under normal operating conditions, consist of emis-sions of pollutants and waste heat to the atmos-phere and to water bodies, and in the case of coal: the solid wastes, land use and water pollution associated with mining, processing and burning it. Control methods of varying cost and effectiveness exist for all significant emissions with the exception Control methods of varying cost and effectiveness exist for all significant emissions with the exception of carbon dioxide, which may have an important influence on global climate, though the causeffect relationship is as yet uncertain. For other pollutants, the main issues are the degree to which these should be controlled and, related to this, the costs and benefits of control. While a comparative assessment of the environmental impacts and methods of controlling them for different types of elecassessment of the environmental impacts and meth-ods of controlling them for different types of elec-tricity generation does not conclusively demon-strate that any one type of generation is environ-mentally superior, it does point the way to a number of environmentally favorable strategies for electricity generation in the future. Several strate-gies for reducing the environmental impact are presented. (Lantz-PTT) W88-08503

THREAT TO THE NEW YORK CITY WATER SUPPLY - PLUTONIUM, Department of Energy, New York. Environmental Measurements Lab.

Department of Energy, New York. Environmental Measurements Lab.
D. C. Bogen, P. W. Krey, H. L. Volchok, J. Feldstein, and G. Calderon.
Science of the Total Environment STENDL, Vol. 70, p 101-118, March 1988. 1 fig, 5 tab, 5 ref.

Descriptors: *New York, *Terrorism, *Plutonium, *Drinking water, *Water supply systems, *Water pollution sources, *Legal aspects, Isotope studies, Institutional constraints, Political aspects, Water treatment facilities, Threats, Radioactivity.

The mayor of the City of New York received an anonymous letter on April 1st 1985 threatening to contaminate the water supply with plutonium unless all criminal charges against Mr. Bernard Goetz, the suspect in the dramatic subway shooting incident, were dismissed by April 11th 1985. Local and Federal authorities were called upon to evaluate the credibility of the threat and to institute a 'round the clock' monitoring program by New York City personnel. The Environmental Measurements Laboratory, EML, was requested by the City to analyze a composite, large volume (175 liters) drinking water sample collected by City personnel on April 16th 1985. The concentration measured was 21 fCi/L which was a factor of 100 greater than previously observed results in the data base, and the mass isotopic content of the plutonium was very unusual. Additional samples were collected one to three months later at various distribution points in the water supply system. The were collected one to three months later at various distribution points in the water supply system. The plutonium concentrations were much lower and comparable to EML's earlier data. Mass isotopic analysis of these samples provided more reasonable compositions but with high uncertainties due to very low plutonium concentration. Recent measurements of large volume samples, 1000 liters, collected in the Fall of 1985 from the New York City and New Lersey water supplies showed identical and New Jersey water supplies showed identical plutonium concentrations of 0.05 fCi/L. Mass isotopic analyses indicated similar 240Pu/239Pu ratios which were slightly lower than global fallout estimates. Due to an inability to confirm the elevated plutonium concentration value for the composite sample of April 16th 1985, it is impossible to con-clude whether the threat to contaminate the New York City water supply was actually carried out or whether the sample was contaminated prior to receipt at EML. (Author's abstract) W88-0860.

FOREST HARVEST AND SITE PREPARATION EFFECTS ON STORMFLOW AND PEAKFLOW OF EPHEMERAL STREAMS IN THE OUA-CHITA MOUNTAINS, Oklahoma State Univ., Stillwater. Dept. of Forest-

ry. E. L. Miller, R. S. Beasley, and E. R. Lawson. Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 212-218, April-June 1988. 3 fig, 6 tab,

Descriptors: *Environmental effects, *Logging, *Streams, *Forest hydrology, *Flood peak,

*Runoff, *Storm runoff, Clearcutting, Ouachita Mountains, Arkansas, Forest watersheds, Water-sheds, Forest soils, Soil properties, Ephemeral streams, Streamflow, Water yield, Rainfall.

Storm flow and peak flow response to three silvicultural treatments-clearcutting, selection cutting, and no disturbance (control)-were compared in a replicated small watershed study in the Ouachita Mountains of Arkansas. Watersheds were blocked Mountains of Arkansas. Watersheds were blocked according to aspect, location, soils, and geology in a randomized complete block design to test effects of treatments. Soils on the watersheds are shallow and were derived from sandstones and shale parent materials. Annual precipitation totals ranged from 72 to 142% of the long-term average (131.7 cm) during the study and a single saintern average. 72 to 142% of the long-term average (131.7 cm) during the study, and a single rainstorm exceeding the 100-year, 24-hour event occurred the second year following harvest treatments. Overall, stormflow water yields did not increase significantly due to forest harvest treatments apparently because permeable soils and subsurface geology allowed deep seepage at the expense of stormflow. However, a treatment response was observed within one er, a treatment response was observed within one block; there was clearly a difference in storm flow response between blocks of watersheds. Annual orm flow as a percentage of precipitation ranged form 2 to 59% across watersheds and years. Over-all peak flows did not increase significantly due to treatment, but a treatment response was observed within one block of watersheds; there was a signifireturn to the total of watersheus; there was a significant difference in peak flows between blocks. Treatment differences in storm flow and peak flow for the 100-year event were not significant. Storm flow to precipitation ratios for this event ranged from 0.63 to 0.81. (See also W88-08756) (Author's abstract) abstract) W88-08755

FOREST HARVEST AND SITE PREPARATION EFFECTS ON EROSION AND SEDIMENTATION IN THE OUACHITA MOUNTAINS, Oklahoma State Univ., Stillwater. Dept. of Forest-

E. L. Miller, R. S. Beasley, and E. R. Lawson. Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 219-225, April-June 1988. 3 fig, 7 tab,

Descriptors: *Environmental effects, *Erosion, *Soil erosion, *Sedimentation, *Logging, *Forest hydrology, Runoff, Storm runoff, Clearcutting, Ouachita Mountains, Arkansas, Forest watersheds, Watersheds, Forest soils, Soil properties, Suspended solids, Turbidity, Sediment yield, Soil loss, Streams, Suspended sediment.

Soil erosion and sedimentation effects of three Soil erosion and sedimentation effects of three silvicultural treatments-clearcutting, selection cutting, and no disturbance (control)—were compared in a replicated small watershed study conducted in the Ouachita Mountains of Arkansas on shallow soils derived from sandstones and shales. Clearcuting significantly increased annual sediment yields over selection and control treatments in 1981, the first year, after treatment but not in 1982 or 1983. first year, after treatment but not in 1982 or 1983. Clearcut to control sediment yield ratios were 20:1, 6:1, and 2.6:1 in 1981, 1982, and 1983, respectively. or, and 2.0:1 in 1761, 1762, and 1783, respectively. First-year sediment losses from clearcuts averaged 237 kg/ha. Stream channels were stable, but they still may have been the primary source of the sediment losses. Erosion following harvest and site preparation did not exceed estimates of long-term soil formation rates. Long-term soil losses. preparation did not exceed estimates of long-term soil formation rates. Long-term soil losses were projected to average 70 kg/ha/yr over a 35-year rotation period with clearcutting while control rates were projected to average 50 kg/ha/yr. A comparison of soil losses measured in this study with baseline rates and estimated soil loss tolerances suggests site productivity need not be threatened by silviculturally induced soil erosion. Suspended soilois levels of storm flow were less than 100, 50, and 20 mg/liter at least 99, 98, and 97% of the time, respectively, across treatments. Only at the 10 mg/liter level was there a significant total suspended solids time differential in watershed storm flow between clearcut or selection cut and control treatments. (See also W88-08755) (Author's abstract)

CHANGES IN NITROGEN, PHOSPHORUS AND PHYTOPLANKTON COMPOSITION DURING THE PAST DECADE IN THE BAY OF ARATU SALVADOR (BAHIA) BRAZIL, Dow Chemical U.S.A., Midland, MI. Mammalian and Environmental Toxicology. For primary bibliographic entry see Field 5B. W88-08808

4D. Watershed Protection

INFILTRATION, MACROPOROSITY, AND MESOPOROSITY DISTRIBUTIONS ON TWO FORESTED WATERSHEDS, Oak Ridge National Lab., TN. Environmental Sciences Div. For primary bibliographic entry see Field 2G. W88-07986

CALIBRATION OF WATER-BALANCE MODEL FOR SMALL WATERSHEDS IN EASTERN OREGON, Chequamegon National Forest, Park Falls, WI.

For primary bibliographic entry see Field 2A. W88-08042

MODEL PREDICTIONS OF WATERSHED EROSION COMPONENTS. Oak Ridge National Lab., TN. Engineering Phys-For primary bibliographic entry see Field 2J. W88-08049 ics Section

STREAM MANAGEMI GLOBAL SIMILARITIES, MANAGEMENT: EMERGING Lund Univ. (Sweden). Stream and Bethic Ecology Group. For primary bibliographic entry see Field 5G. W88-08223

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

FEASIBILITY OF USING SEQUENTIAL EX-TRACTION TECHNIQUES FOR ARSENIC AND SELENIUM IN SOILS AND SEDIMENTS. Geological Survey, Menlo Park, CA. K. A. Gruebel, J. A. Davis, and J. O. Leckie. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 390-397, March-April 1988. 2 fig, 7 tab, 46

Descriptors: *Sequential extraction, *Arsenic, *Selenium, *Analytical methods, *Soil chemistry, *Chemical analysis, Soils, Sediments, Minerals, Oxidation, Adsorption, Iron oxides, Organic

Laboratory experiments were conducted with well-characterized minerals to test the applicability of selective extraction schemes for Se and As partitioning in soils and sediments. Two specific steps were tested: the reductive dissolution of amorphous iron oxides and the oxidation of organ-ic material. Selenium and As associated with amorphous iron oxides were usually not found in solu-tion after reductive dissolution, due to readsorption non after reducered assonance, due to reassorption onto other minerals unaffected by the extractant. Oxidants intended to dissolve organic material also oxidized Se(IV) adsorbed on a mineral to Se(VI), causing the release of Se(VI) to the extractant solution. The selective extraction schemes which are currently available do not appear to produce reliable results for Se and As partitioning among sediment components. (Author's abstract)

DETERMINATION OF INORGANIC ARSENIC (III) AND ARSENIC (III PLUS V) USING

Group 5A—Identification Of Pollutants

HYDRIDE-GENERATION AUTOMATED ATOMIC-ABSORPTION SPECTROMETRY, Agricultural Research Service, Riverside, CA. Sa-

Inity Lab.

R. A. Glaubig, and S. Goldberg.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 536-537, March-April 1988. 1 tab, 12 ref.

Descriptors: "Arsenic, "Reduction, "Hydrides, "Chemical analysis, Analytical methods, Measuring instruments, Spectrophotometry, Spectroscopy, Heavy metals, Detection limits, Sample prepa-

ration.

A simple method was developed to analyze aqueous inorganic arsenic in the microgram/L rangeusing automated hydride-generation atomic-adsorption spectrometry. Total inorganic arsenic, As(III plus V), was determined by reducing As(V) to As(III) using KI then generating the hydride in 6 M HCl. Arsenic (III) was determined by generating the hydride at pH 4.0 to 4.5 using an oxalate buffer. Detection limits for the As(III) plus V) and As(III) analytical methods were less than 0.4 micrograms As/L. Arsenic(V) was calculated by difference. Spliting of actual sample solutions with As(III) and As(V) showed the procedure to be accurate on solutions with initial pH values ranging from 2.7 to 9.8 and As(III)/As(V) ratios ranging from 1.4 to 4.1. Recoveries of As were within 1.3 micrograms A/L of added amounts ranging from 10.0 to 40.0 micrograms As/L. Automated hydride generation allowed analysis at a rate of 53 samples per h, a significant rate increase over traditional batch hydride generators. Spontaneous oxidation of As(III) to As(V) was observed on spiked samples mixed 3 h before analysis. (Author's abstract) stract) W88-08002

COMPARISON OF THE GRAPHICAL AND STANDARD METHODS FOR THE DETERMI-NATION OF BIOCHEMICAL OXYGEN DEMAND.

Univ., TX. Environmental Engineering

Frogram.

S. L. Woodring, and D. A. Clifford.

Journal Water Pollution Control Federation

JWPFA5, Vol. 60, No. 4, p 537-542, April 1988. 7

fig. 1 tab, 6 ref.

Descriptors: "Wastewater treatment, "Biological wastewater treatment, "Biochemical oxygen demand, "Water quality standards, "Graphical analysis, Statistical analysis.

The graphical and Standard Methods for the deter-The graphical and Standard Methods for the determination of biochemical oxygen demand (BOD) were compared. Average means + or - standard deviation of 228 + or - 28 mg/l and 199 + or - 25 mg/l for the Standard Methods and graphical methods resulted when a primary standard was used. The graphical method showed no significant difference from the accepted Standard Methods procedural check value of 200 + or - 37 mg/l. Analytical procedures used for both methods were identical except for the separate seed correction set up in the Standards Methods approach. The disagreement was eliminated by use of a seed correction derived from the graphical method. No significant differs see between the results of the two methods occurred when effluent and raw methods occurred when effluent and raw methods occurred when effluent and raw wastewater samples were used. Nitrification and exertion of dilution water ammonia oxygen demand are suspected to be the cause of seed demand are suspected to be the cause of seed variations and further studies should use nitrification inhibition to examine these occurrences. The graphical methods accounts for these interferences, which would make it a very useful procedure when examining nitrogenous oxygen demand. The graphical method use may be limited by the necessity of obtaining a range of valid kilutions to provide adequate data for plotting. A paired comparison test of the graphical method and Standard Methods BOD determinations on effluent samples where the 2 mg/L depletion was relaxed only in the graphical method showed no significant difference between the results of both procedures. The graphical method can increase reliability in BOD data and should enable better confidence in secondary and tertiary effluent BOD levels of biological processes where very low BOD levels are cal processes where very low BOD levels are obtained. (Author's abstract)

W88-08011

DIARRHETIC SHELLFISH POISONING IN NARRAGANSETT BAY, Rhode Island Univ., Narragansett. Graduate Rhode Island Univ., Narragansett. Graschool of Oceanography. For primary bibliographic entry see Field 2L. W88-08015

ANALYSIS OF RAIN WATER BY DIFFEREN-TIAL-PULSE STRIPPING VOLTAMMETRY IN NITRIC ACID MEDIUM, Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

istry.

Z. Komy, E. Roekens, and R. Van Grieken.

Analytica Chimica Acta ACACAM, Vol. 204, No.

1/2, p 179-187, January 15, 1988. 3 fig. 3 tab, 7 ref.

European Economic Community Grant No.

EV3V-0928-B (GDF).

Descriptors: *Pollutant identification, *Differential-pulse stripping voltammetry, *Water analysis, *Heavy metals, *Voltammetry, Cadmium, Lead, Copper, Zinc, Cobalt, Nickel, Rain.

Differential-pulse anodic stripping voltammetry is applied to determine cadmium, lead and copper in rain water acidified with nitric acid to pH 1.5, and zinc after partial neutralization to pH 4.5. Subsezinc after partial neutralization to pH 4.5. Subsequently, cobalt and nickel are measured in the adsorptive mode after formation of their dimethylglyoximates. The effects of pH on the stripping peak of Zn, Cd, Pb and Cu and of chloride on the stripping peak of copper are reported. Good agreement is found with determinations by this method in hydrochloric acid medium and with method in hydrochloric acid medium and with atomic absorption spectrometry measurements in most cases. Excellent accuracy is demonstrated. The average relative standard deviation per measurement appears to be between 12 and 22% for the overall analytical procedure for concentrations of 0.15-50 microgram/liter of the various metals in the samples. (Author's abstract) W88-08022

TOXICITY OF MANGANESE AND ITS IMPACT ON SOME ASPECTS OF CARBOHYDRATE METABOLISM OF A FRESHWATER TELEOST, COLISA FASCIATUS, Gorakhpur Univ. (India). Dept. of Zoology. For primary bibliographic entry see Field 5C. W88-08071

TOXIC SITUATION OF LEPIDIUM SATIVUM IN THE WUPPER-RIVER: A SUPPLEMENTAL METHOD OF WATER QUALITY SURVEIL-LANCE (DIE TOXIKOLOGISCHE SITUATION DER WUPPER GEGENUEBER DER GAR-TENKRESSE (LEPIDIUM SATIVUM): EINE ERGAENZENDE METHODE DER GEWAES-SERGUETEUEBERWACHUNG),

Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 3, p 81-93, June 1987. 2 fig, 2 tab, 7 ref.

Descriptors: *Water quality, *Water quality standards, *Bioindicators, *Garden cress, *Toxicity, *Water pollution effects, Ecological effects, Plant pathology, Plant growth, Heavy metals, Simulation, Rivers, Germany, Cress seed test.

Using the 'cress-seed test' it can be demonstrated that the Wupper River below Marienhagen has an inhibitory effect on the growth of the roots of garden cress (Lepidium sativum). It can be shown by simulation tests that this inhibition, which ex-tends as far as Wuppertal-Rutenbeck, is caused by an increased heavy-metal burden. These results are substantiated by experimental determination of the ecological valence of Lepidium sativum: (Author's W88-08148

DETERMINATION OF ORGANIC GROUP PARAMETERS-AOCL, AOBR, AOS IN WATER BY MEANS OF ION-CHROMATOGRAPHIC DETECTION: ENRICHMENT OF MODEL

SUBSTANCES AND ELIMINATION OF THE INORGANIC ANION ADSORPTION (BESTIMMUNG DER ORGANISCHER GRUPPENPARAMETER AOCL, AOBR, AOS IN WAESSERN MIT IONENCHROMATOGRAPHISCHER DEFENTION, ADSORPTION ORGANISCHER DEFENTION, ADSORPTION ORGANISCHER TEKTION: ADSORPTION ORGANISCHER DE-TEKTION: ADSORPTION ORGANISCHER MODELLSUBSTANZEN UND VERDRAEN-GUNG ANORGANISCHER ANIONEN AUF CHLOR- UND SCHWEFELFREIER AKTIV-KOHLE),

Gesamthochschule Paderborn (Germany, F.R.). Dept. of Applied Chemistry.

G. Brandt, and A. Kettrup.

Zeitschrift fuer Wasser- und Abwasser-Forschung

ZWABAQ, Vol. 20, No. 4, p 133-138, August

1987. 12 fig. 4 tab, 19 ref.

Descriptors: *Chemical analysis, *Organic compounds, *Inorganic compounds, *Anions, *Halides, *Chlorides, *Bromides, *Sulfides, *Adsorption, *Chromatography, Sulfur compounds, Adsorbents, Activated carbon, Population exposure.

Organohalides are a group of compounds of considerable interest in the field of water research because they are generally suspected of causing adverse health effects. The analysis of organohalides in water as a group parameter, e.g., 'adsorbable organic halides' recognizes that many such compounds are unaccounted for by methods designed to identify individual compounds. The differentiation of another parameter, 'adsorbable organic sulfur compounds' can be performed using ion chromatography for detection of anions obtained after pyrohydrolysis of the organic adsorbed compounds. Investigations concerning the enrichment of organic solutes on a nearly chlorineand sulfur-free active charcoal have been performed. Experiments have also been carried out to reduce adsorption of interfering organic anions. reduce adsorption of interfering organic anions.
(Author's abstract) W88-08154

INVESTIGATIONS ON SPECTRAL INTERFER-ENCES IN ICP-AES (UNTERSUCHUNGEN UEBER SPEKTRALE INTERFERENZEN IN DER ICP-AES),

W. Jaeger, and I. Horn.

Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 138-141, August 1987. 2 fig, 2 tab, 6 ref.

Descriptors: *Chemical analysis, *Water analysis, *Atomic emission spectroscopy, *Wastewater analysis, *Soil analysis, *Metals, *Spectral analysis, Aluminum, Tin, Mercury, Arsenic, Selenium, Antimony, Bismuth, Interference, Detection limits, Sludge.

Water, wastewater, sludge, and soil analysis for metals is of great importance in environmental analysis. Inductive coupled plasma-atomic emission spectroscopy (ICP-AES) is known as a precise, fast, and cost-effective method for this purpose. There is, however, the problem of spectral interference. This problem is the subject of this study with the ICP Plasma Spec 2.5. Thirty-five elements were investigated and in 19 cases interference was observed. Two particularly interesting examples are represented by the metals aluminum and tin, for which no interference-free spectral lines could be found. For the group of hydrideforming elements (mercury, arsenic, selenium, antimony, and bismuth) the combination ICP-Plasma Spec 2.5-MHH-S was used to check on interfermony, and bismuth) the combination ICP-Plasma-Spec 2.5--MHH-S was used to check on interfer-ences and detection limits. (Author's abstract) W88-08155

APPLICATION OF ENZYME ASSAYS FOR TOXICOLOGICAL WATER TESTING, ESWE-Inst. fuer Wasserforschung und Wassertechnologie G.m.b.H., Weisbaden (Germany,

U. Obst, A. Holzapfel-Pschorn, and M. Wiegand-

Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 20, No. 5, p 151-155, October 1987. 6 fig, 1 tab, 7 ref.

Identification Of Pollutants-Group 5A

Descriptors: *Water analysis, *Testing procedures, *Enzymes, *Toxicity, *Microbiological studies, Enzyme assays, Microflora.

Two different criteria for biochemical toxicity test-ing are proposed: The effect of hazardous sub-stances on the metabolic activity of the natural microflora and the determination of such sub-stances by a standardized enzyme testing system. To measure effects on the microbial metabolic activity there are various simple in vivo enzyme assays using chromogenic or fluorogenic substrates. To detect unknown substances with harmstrates. To detect unknown substances with narm-ful effects there exist some in vitro enzyme tests with commercial preparations of defined purity and sensitivity. The performance, sensitivity, and some data on the practical use of such tests are presented. (Author's abstract) W88-08157

REPORT ABOUT EXPERIENCES IN INTER-COMPARISON STUDIES IN THE ADMINIS-TRATION FOR WATER ECONOMY OF RHEINLAND-PFALZ,

RHEINLAND-PFALZ, Landesamt fuer Wasserwirtschaft Rheinland-Pfalz, Mainz (Germany, F.R.). H. Blandfort, R. Buttstedt, H.J. Hemmrich, H. Jung, and D. Rinne. Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 20, No. 5, p 168-173, October 1987. 1 fig, 6 tab, 14 ref.

Descriptors: *Sulfates, *Chloride, *Ammonuim, *Comparison studies, *Chemical analysis, *Chemical oxygen demand, *Biological oxygen demand, *Legislation, *Water analysis, Rheinland-Pfalz.

A short report is given for some intercomparison studies of COD (chemical oxygen demand), BOD5 (biological oxygen demand), NH4(+)-N, CI- and SO4(2-) by laboratories of the administration for water economy of Rheinland-Pfalz. The results obtained from studies in the years 1980-1985 are satisfactory, but they give reason to criticize the analytical procedure in the COD determination and in the establishment of values required for the implementation of the Federal Water Acts. (Author's abstract) thor's abstract) W88-08160

COMPARISON OF STATIONARY HPLC-PHASES FOR THE SEPARATION OF POLY-CYCLIC AROMATIC HYDROCARBONS (16 PAH'S OF NBS-STANDARD),

Gesamthochschule Paderborn (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik.

H.G. Kicinski, and A. Kettrup.

Zeitschrift fuer Wasser - und Abwasser Forschung

ZWABAQ, Vol. 20, No. 5, p 174-179, October

1987. 9 fig. 4 tab, 6 ref.

Descriptors: *Water analysis, *Aromatic compounds, *Hydrocarbons, *Pollutants, *Chemical analysis, *Chromatography, High performance liquid chromatography, Fluorescence.

Stationary phases of several column distributors were studied and compared for the separation and determination of the 16 polycyclic compounds included in the EPA (Environmental Protection Agency) Priority Pollutant List using an HPLC (high performance liquid chromatography) gradient program. In addition to the UV (ultraviolet light) detection, the more selective and sensitive fluorescence method was tested by using the wavelength programmable fluorescence detection. (Author's abstract) W88-08161 W88-08161

HEADSPACE TECHNIQUE TO DETERMINE THE PRESENCE OF VOLATILE HYDROCARBONS IN DRINKING WATER. THE PROBLEMS ARISING FROM THE PREPARATION OF A BLANK SAMPLE AS WELL AS THE CLEANING OF THE SAMPLE APPARATUSES,

Gemeinnutzige G.m.b.H., Algau (Germany, F.R.). H.J. Briegel, and W. Brunn. Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 20, No. 5, p 180-182, October 1987. 2 fig, 5 ref.

Descriptors: *Drinking water, *Water analysis, *Chemical analysis, *Air pollution, Volatile halo-carbons, Hydrogen peroxide, Quantitative analysis, Laboratory equipment, Interference.

A demonstration is provided of how necessary it is to cleanse in a special manner the test tubes as well as the blank sample used to determine the presence of volatile hydrocarbons. In almost every laboratory it is inevitable that traces of these substances are ry it is inevitable that traces of these substances are present in the air which could falsify a quantitative determination of halocarbons. Hydrogen peroxide not only helps clean the test tubes of possible halocarbon impurities but also can be used to prepare a blank solution which is virtually free of volatile hydrocarbons. The proposed cleaning procedures are simple and can be carried out in a short time. (Author's abstract) W88-08162

APPLICATION OF DIALYSIS BAGS FOR MONITORING THE GROUNDWATER QUALITY DOWNSTREAM OF A LANDFILL, yreuth Univ. (Germany, F.R.). Lehrstuhl fuer

Hydrologie.
W. Schafer, and S. Peiffer.
Zeitschrift fuer Wasser - und Abwasser Forschung
ZWABAQ, Vol. 20, No. 6, p 197-202, December
1987. 7 fig, 4 tab, 30 ref.

Descriptors: *Water analysis, *Path of pollutants, *Monitoring, *Water pollution sources, *Dialysis, *Water quality, *Landfills, *Groundwater pollution, Chemical analysis, Dialysis bags, Membrane processes, Quantitative analysis, Cations, Anions.

By means of dialysis bags the physico-chemical conditions in groundwater downstream of a former landfill site were investigated. Zone, characterized by ion concentration and ion content and the actual redox conditions, was found in vertical as well as in horizontal directions. Different redox conditions highly influenced the inorganic pollutant transport out of the landfill site and are therefore important for the evaluation of the bassed ant transport out the landuil site and are there-fore important for the evaluation of the hazard potential. The dialysis bags proved to be an inex-pensive and suitable means for the determination of depth profiles of groundwater, the quantitative determination of major anions and cations, and the characterization of redox zonings. However, a quantitative determination of heavy metals was not possible. (Author's abstract)

W88-08165

VOLTAMMETRIC DETERMINATION OF MERCURY IN A SEWAGE SLUDGE SAMPLE, Fachhochschule Aachen (Germany, F.R.). For primary bibliographic entry see Field 7B. W88-08167

COMPARISON OF STATIONARY HPLC-PHASES FOR THE SEPARATION OF POLY-CYCLIC AROMATIC HYDROCARBONS (6 PAH'S OF TOV), Gesamthochschule Paderborn (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik.

M. Luhrmann, H.G. Kicinski, and A. Kettrup. Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 20, No. 6, p 212-215, December 1987. 6 fig, 3 tab, 3 ref.

Descriptors: *Aromatic compounds, *Pollutant identification, *Chemical analysis, *Laboratory equipment, *Water analysis, *Pollutant identification, *Chromatography, Polycyclic aromatic hydrocarbons, High performance liquid chromatography, Fluorescence detection.

Stationary phases of several column distributors were studied and compared for the high performance liquid chromatographic (HPLC) separation of the 6 polycyclic aromatic hydrocarbons listed in the German Drinking Water Ordinance (TOV): fluoranthene, benzo(k)fluoranthene, benzo(k)fluoranthene, benzo(b)fluoranthene, benz(a)pyrene, indeno(1,2,3-cd)pyrene, and benz(g,h,i)perylen. (Brock-PTT) W88-08168

DETERMINATION OF TRIAZINE-HERBI-CIDES AND THEIR METABOLITES IN

WATER SAMPLES BY GAS CHROMATOGRA-

WALER SAME LESS COMMENTS OF THE SAME LESS CO

Descriptors: *Water analysis, *Herbicides, *Pesticides, *Pollutant identification, *Chemical analysis, Triazine, Gas chromatography.

The triazine herbicides are extracted from an alkaline water sample into dichloromethane (extraction ratio 1:10). An aliquot of the extract is evaporated to dryness in a rotary vacuum evaporator to dryness and the residue dissolved in 1 ml acetone. The ness and the restouc dissolved in 1 m accorde. The triazine herbicides are determined by gas chromatography using a nitrogen selective detector after separation on a capillary column. (Author's abstract)
W88-08173

QUALITATIVE UV SPECTROSCOPIC METHOD AS AN INITIAL GUIDE TO SOURCE ORIGINS OF POLYCYCLIC AROMATIC HYDROCARBONS,

National Univ. of Singapore. Dept. of Chemistry. For primary bibliographic entry see Field 5B. W88-08197

STUDIES ON METAL CONTENT IN THE BROWN SEAWEED, FUCUS VESICULOSUS, FROM THE ARCHIPELAGO OF STOCK-

Uppsala Univ. (Sweden). Dept. of Physiological Botany. For primary bibliographic entry see Field 5B. W88-08199

VERIFICATION OF A NUMERICAL BEACH WATER QUALITY MODEL.

Gore and Storrie Ltd., Toronto (Ontario).
M. D. Palmer, and R. J. Dewey.
Canadian Journal of Civil Engineering CJCEB8,
Vol. 14, No. 4, p 559-570, August, 1987. 12 fig, 3 tab, 6 ref, 2 apper

Descriptors: *Water pollution sources, *Model testing, *Mathematical models, *Beaches, *Water quality, *Coliforms, *Population density, Bacteria, Density, Storm runoff, Water currents, Bathymebeisty, storin fullott, water currents, bartyne-try, Mortality, Wind, Population dynamics, Cali-brations, Surveys, Prediction, Water quality man-agement, Water pollution, Combined sewers.

A dynamic two-dimensional finite difference water quality model was developed to predict the fecal coliform densities at the Toronto, Ontario, Eastern Beaches resulting from storm-water discharges. There are 10 storm-water and 2 combined sewer overflows discharging to the beach. Site-specific overriows discharging to the beach. Ste-specific data collected for use in the model included local bathymetry, currents, dispersion, fecal coliform mortality rates, winds, receiving water fecal coliform densities, and discharge pollutographs. Specially designed field fecal coliform surveys were required to calibrate and verify the model, since the storm effects are very dynamic in both time and space. The verified model was then used to estimate the reduction in fecal coliform densities at estimate the reduction in-fecal colliform densities at the beaches for different intensity storms for differ-ent remedial works. Management alternatives eval-uated included relocating outfalls farther offshore, combining outfalls, removing some discharges by diverting the flows to the treatment plant via storm retention tanks, and treatment of some discharges. retention tanks, and treatment of some discharges. The improvements resulting from the different re-medial works were quantified as the number of hours when the fecal coliform densities exceeded 100 counts/dL. (Doria-PTT) W88-08212

EFFECT OF SURFACTANTS ON THE DETER-MINATION OF NITRITE AND NITRATE IN WATER SAMPLES, Thessaloniki Univ., Salonika (Greece). Environ-

Group 5A—Identification Of Pollutants

mental Pollution Control Lab. A. Martiadou-Nikolopoulou, and T. Kouimtzis. Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 330, No. 2, p 120-122, March 1988. 2 tab, 7 ref.

Descriptors: *Pollutant identification, *Surfactants, *Nitrates, *Nitrites, *Pollutants, *Nitrogen cycle, *Detergents, Azodye, Nonionic surfactants, Cationic surfactants, Anionic surfactants, Spectrophotometry, Greece.

The effect of four surfactants on the determination The effect of four surractants on the determination of nitrite and nitrate has been examined. The method which has been tested for nitrite is based on the formation of an azodye. The results show that cationic and non-ionic surfactants do not interfere with the determination of nitrite while anionic surfactants cause significant interferences which could be eliminated by treating the water samples with a cationic surfactant. Two methods have been tested: (1) based on the nitration of salicylic acid and (2) based on the reduction of nitrate to nitrite. Results for the first method show that the non-ionic surfactant Triton-X causes significant inter-ferences. Cationic and anionic surfactants do not interfere when their concentration is relatively low. For higher concentrations, an increasing in-terference is observed. Results for the second method show effects similar to those obtained for nitrite. (Author's abstract) W88-08240

DETERMINATION OF TRI-N-BUTYLTIN AND DI-N-BUTYLTIN COMPOUNDS IN FISH BY GAS CHROMATOGRAPHY WITH FLAME PHOTOMETRIC DETECTION, National Inst. of Hygienic Sciences, Tokyo

PHOTOMERIC DETECTION, National Inst. of Hygienic Sciences, Tokyo (Japan) Div. of Foods. K. Sasaki, T. Ishizaka, T. Suzuki, and Y. Saito. Journal - Association of Official Analytical Chemists JANCAZ, Vol.71, No. 2, p 360-363, March/ April 1988. 3 fig. 2 tab, 15 ref.

Descriptors: *Pesticides, *Gas chromotography, *Tri-n-butyltin, *Di-n-butyltin, *Flame photometry, *Fish, *Pollutant identification, *Tissue analysis, Yellowtails, Butyltin compounds, Microbiological studies, Pollutants, Jana

Various tri-n-butyltin and di-n-butyltin compounds have been widely used as stabilizers of poly(vinyl chloride), fungicides, and marine antifoulants, and they are known to be aquatic environmental contaminants. An analytical method is described for the simultaneous quantitative determination of trin-butlytin and di-n-butlytin compounds in fish. The sample was extracted with 0.5N HCL-methanol and the methanol solution was extracted with hexane. The extract was purified by gel permeation chromotography and treated with Grignard respent to yield the methyl derivatives which were determined by gas chromotography with flame photometric detection operated in the tin mode (610 nm). Recoveries of tri-n-butyltin chloride (Bu3SnCl) and di-n-butyltin dichloride (Bu2SnCl) spiked to fish at levels of 0.2 and 0.1 ppm ranged inants. An analytical method is described for (Bu3SnC!) and di-n-butyltin dichloride (Bu2SnCl2) spiked to fish at levels of 0.2 and 0.1 ppm ranged from 80 to 105%. Detection limits were 0.02 micrograms per gram for both compounds. Tri-n-butyltin compounds equivalent to Bu2SnCl2 levels of 0.02-0.11 ppm were found in reared yellowtails and these values showed good agreement with the results from gas chromatagraphic-mass spectrophotometric analysis. (Author's abstract) photometri W88-08241

INTERCOMPARATIVE STUDY ON THE DE-TERMINATION OF POLYNUCLEAR ARO-MATIC HYDROCARBONS IN MARINE SHELLFISH TISSUE, Department of Fisheries and Oceans, Halifax (Nova Scotia). Physical and Chemical Sciences

J. F. Uthe, and C. J. Musial.

Journal - Association of Official Analytical Chemists JANCA2, Vol.71, No. 2, p 363-368, March/April 1988. 5 tab, 14 ref.

Descriptors: *Polynuclear aromatic hydrocarbons, *PAH, *Shellfish, *Marine animals, *Pollutants, *Pollutant identification, *Hydrocarbons, *Tissue

analysis, Lobster, Microbiological studies, Canada, Comparative studies, Shellfish physiology, Statisti-cal methods, Liquid chromatography.

Polycyclic aromatic hydrocarbons (PAH) are ubiquitous environmental contaminants, particularly in the near shore marine environment because of various discharges and because of their use as wood preservatives in coastal marine structures. Many PAHs have been identified as carcinogens or wood preservatives in coastal marine structures. Many PAHs have been identified as carcinogens or cocarcinogens in a variety of test systems and have, therefore, been a subject of analytical interest. PAHs have been shown to accumulate in a variety of shellfish, such as lobsters and mussels; levels of 2 to 3 orders of magnitude above background have been reported in lobsters from areas receiving discharges from coal-coking facilities. Twenty-five laboratories were sent two materials: (1) an acetone powder of lobster digestive gland and (2) the oil which had been extracted during preparation of the powder. Each laboratory was requested to measure the levels of a suite of Polycyclical aromatic hydrocarbons in both materials. The response was poor with only ten laboratories submitting results. Both intra- and inter-laboratory precisions were poor; the interlaboratory error was so great as to preclude statistical analysis of the error. Relative standard deviations for oil results determined by liquid chromatography ranged from 39 to 69%. (Miller-PTT)

DIFFERENTIAL COURTSHIP ACTIVITY OF COMPETING GUPPY MALES (POECILIA RETICULATA PETERS; PISCES: POECILIDAE) AS AN INDICATOR FOR LOW CONCENTRATIONS OF AQUATIC POLLUTANTS, Gesellschaf füer Strahlen- und Unweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).

Inst. fuer Strahlenbiologie.
J. H. Schroeder, and K. Peters.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 3, p 396-404, March 1988. 3 fig, 12 ref.

Descriptors: *Animal behavior, *Pollutant identification, *Water pollution effects, *Fish, *Courtship activity, *Guppies, Aquatic pollutants, Statistical methods, Marine pollution.

The main purpose of the study was to demonstrate that toxic effects of low concentrations of water-borne pollutants may easily be checked by scoring social behavior activities of the male guppy. To score both frequency and duration of the male sexual activities, an event recorder was used. Change of mean differential courtship activity were calculated for pairs of competing males in Change of mean differential courtsup activity, were calculated for pairs of competing males in two experiments: (1) the addition of lindane (hexachloride) benzene hexachloride) to aquaria containing Munich tapwater and (2) the use of 10% wastewater from the last clearing basin of a Munich experience plant. The authors, concluded Munich sewerage plant. The authors concluded that examination of more than one genetically defined animal stock is required to check the possible toxic effects of environmental pollution on social behavior activities. (Miller-PTT) W38-08248

INDUCTION OF MICRONUCLEI AND NU-CLEAR ABNORMALITIES IN THE ERYTHRO-CYTES OF MUDMINNOWS (UMBRA LIMI) AND BROWN BULLHEADS (ICTALURUS NE-BULOSUS),

Trent Univ., Peterborough (Ontario). Environmental and Resource Studies Program.

C. D. Metcalfe.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 4, p 489-495, April 1988. 3 tab, 10 ref.

Descriptors: *Fish, *Carcinogens, *Cytogenic studies, *Erythrocytes, *Mudminnows, *Bull-heads, *Water pollution effects, *Bioassay, *Toxicity, *Pollutant identification, Path of pollutants, Tumors, Genotoxicity, Fish physiology, Micronuclei, Nuclear abnormalities, Canada.

An in vivo micronucleus (MN) assay was conducted using the peripheral erythrocytes of the eastern mudminnow (Umbra pygmaea) in an effort to de-

termine whether the MN technique can be developed as an in situ assay for genotoxicity in fish species, in particular, the brown bullhead (Ictalurus nebulosus). Central mudminnows (Umbra lurus nebulosus). Central mudminnows (Umbra limi) and brown bullheads were exposed to ethyl methane sulfonate and benzo(a)pyrene by intraperitioneal injection. It is concluded that this genotoxicity assay may be the only suitable method for in situ toxic monitoring of feral fish for genotoxic activity, but it shows no promise as an in vivo bioassay technique for fish. (Miller-PTT)

INTERMITTENT FLOW SYSTEMS FOR POP-ULATION TOXICITY STUDIES DEMON-STRATED WITH DAPHNIA AND COPPER, Ministry of Transport and Public Works, Lelystad (Netherlands).

C. J. VanLeeuwen, J. L. Buchner, and H. VanDijk.

Valletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 4, p 496-502, April 1988. 3 fig, 1 tab, 11 ref.

Descriptors: *Pollutant identification, *Water pol-Descriptors: Prolutant identification, "water pol-lution effects, "Laboratory equipment, "Population exposure, "Daphnia, "Toxicity studies, "Intermit-tent flow systems, "Flow systems, "Copper, Aquatic populations, Aquatic invertebrates, Path of pollutants, Crustaceans, Aquatic pollution, Chemical pollution, Fish populations, Netherlands.

Until the introduction of continuous-flow procedures, the physical aspects of testing the toxicity of chemicals and aqueous effluents to aquatic organisms had been of minor consideration. Today's nisms had been of minor consideration. Today's devices, ranging from pneumatic systems to electric pumps, all have some drawback. But many of them are reduced to a minimum by the use of proportional diluter which is a well-established and reliable dosing apparatus. However, the Mountanungs diluter cannot be used for testing volatile chemicals, nor does it allow simultaneous dosing of a constant food suspension and several toxicant concentrations which are important conditions for population toxicity studies with small invertebrates like the crustacean Daphnia magna. These restrictions are removed by the use of electric pumps, solenoids and time relays. The system described here provides for the delivery of 250 ml every 5 minutes to 6 hours with no perceptible current-induced effects on the test organisms. The system minutes to 6 hours with no perceptible current-induced effects on the test organisms. The system also allows for the automatic supply of known concentrations of food at each dilution cycle as well as the testing of volatile chemicals. The system has operated for almost three years and has proven to be reliable, accurate and easy to maintain. In order to illustrate its usefulness in tests with Daphnia populations, the toxicity of copper was tested. (Author's abstract) W88-08253

SUBLETHAL EFFECTS OF COPPER AND MERCURY ON SOME BIOCHEMICAL CON-STITUENTS OF THE ESTUARINE CLAM VIL-LORITA CYPRINOIDES VAR. COCHINENSIS

HANLEY, (India). Dept. of Marine Sciences. B. Sathyanathan, S. Muraleedharan, J. Chacko, and P. N. K. Nambisan. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 4, p 510-516, April 1988. 1 fig, 2 tab, 16 ref.

Descriptors: *Pollutant identification, *Water pol-lution effects, *Bioassay, *Copper, *Mercury, *Es-tuarine pollution, *Physiological responses, *Sub-lethal effects, *Biochemical constituents, *Clams, *Estuaries, Path of pollutants, India, Carotenoid content, Aquatic pollution, Animal metabolism.

The usefulness of sentinel organisms in environ-The usefulness of sentinel organisms in environ-mental pollution monitoring or surveillance pro-grams has been well-established. A particularly significant attribute of sublethal physiological re-sponse is that it is amenable to both laboratory and field measurement, unlike traditional toxicant test-ing. Such methods could be employed to develop environmental quality models to predict the bio-logical effects of potential pollutants as well as to

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directly monitor the effects in the environment. This paper describes the effect of sublethal amounts of two well known aquatic pollutants, namely Cu and Hg, on an estuarine clam Villorita copen contents of the cissues of the clam exposed contents of the tissues of the clam exposed to lethal amounts of Cu(II) and Hg(II) were investigated over a range of time. (Author's abstract) W88-08254

REPRESENTATIVENESS OF PORE WATER SAMPLES COLLECTED FROM THE UNSATU-RATED ZONE USING PRESSURE-VACUUM LYSIMETERS. Geological Survey, Denver, CO. Water Resources

For primary bibliographic entry see Field 7B. W88-08314

SIMULATION OF VAPOR TRANSPORT THROUGH THE UNSATURATED ZONE: IN-TERPRETATION OF SOIL-GAS SURVEYS, Hydrosystems, Inc., Falls Church, VA. L. R. Silka. Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 115-123, Spring 1988. 5 fig, 2 tab, 24 ref.

Descriptors: *Soil contamination, *Groundwater pollution, *Pesticides, *Path of pollutants, *Model studies, Volatile organic compounds, Kinetics, Soil water, Chemical properties, Spatial distribution, Soil-gas surveys, Computer models, Simulation analysis, Surveys, Monitoring, Simulation, Diffusion, Organic carbon.

Soil-gas surveys are becoming more widely accept-ed as a tool for the preliminary determination of the extent of soil and ground water contamination ed as a tool for the preliminary determination of the extent of soil and ground water contamination by volatile organic compounds. The interpretation of the results of published soil-gas surveys has been necessarily limited and qualitative due to a lack of adequate models. There has been considerable effort in the recent past to characterize the transport and fate of pesticides generally differ substantially from those of volatile organic compounds. This paper presents a computer model developed to simulate the diffusive transport of volatile organic compound vapor through unsaturated soils using two-dimensional, finite-difference, solution to Fick's second law of diffusion. An effective diffusion coefficient that incorporates the effects of tortuosity, moisture content, and soil organic carbon content is computed. Although the model has not been validated due to the unavailability of adequate field or laboratory data, nevertheless, sensitivity analyses demonstrate the importance of soil moisture and, secondarily, organic matter content in controlling the migration of volatile organic compound vapor through the unsaturated zone. The interpretation of soil-gas surveys can be complicated by unknown spatial heterogeneities in soil moisture and organic carbon content, temporal variations in moisture content, extent of contaminant migration as a non-aqueous phase liquid and by the unknown extent of volatile organic compound vapor through the unsaturated zone. nant migration as a non-aqueous phase liquid and by the unknown extent of volatile organic com-pound liquid and contaminated ground water. (Au-thor's abstract) W88-08316

THREE-DIMENSIONAL ANALYTICAL MODEL TO AID IN SELECTING MONITOR-ING LOCATIONS IN THE VADOSE ZONE, For primary bibliographic entry see Field 7A. W88-08317

SURFACE AND DOWNHOLE GEOPHYSICAL TECHNIQUES FOR HAZARDOUS SITE INVESTIGATION, Technos, Inc., Miami, FL.
For primary bibliographic entry see Field 5B.
W83-08386

DETERMINATION OF TRACE METALS IN SOLUTION BY ION CHROMATOGRAPHY,

Dionex (UK) Ltd., Farnborough (England).

R. A. Cochrane.
IN: Trace Metal Removal from Aqueous Solution The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986. The Royal Society of Chemistry, London. Special Publication No. 61, 1986. p 197-222, 29 fig, 4 ref.

Descriptors: *Pollutant identification, *Ion chromatography, *Trace metals, Chemical analysis, Post column derivatization, Ion exchange, Chro-

Ion chromatography has since its beginning found increased use as an alternative or compliment to conventional methods for the determination of metals. Through the use of ion exchange separaconventional methods for the determination of metals. Through the use of ion exchange separations in a variety of ways and in combination with either suppressed conductivity detection or post column reaction/visible detection, it is possible to detect a wide range of metals in a variety of oxidation states. Post column derivatization is an established technique which chemically modifies the separated components so that they are detectable by one of the common chromatographic detectors (e.g., absorbance, fluorescence). A reagent is continually added to the column effluent so that it reacts selectively with the sample species to form a detectable product. This is the method of choice for detecting heavy metals because they are incompatible with the alkaline regenerant of a suppressed conductivity system. The success of post column derivatization depends on a constant eluent and reagent flow and an efficient mixing system. This is to that reaction times are fast, background noise kept to a minimum and dead volume low to reduce band broadening effects. Post column derivatization offers the following advantages over other analytical methods: (1) Sensitivity ppb levels by direct injection and even lower by trace enrichment techniques; (2) Multi-element technique with variable selectivity; (3) Speciation of important oxidation states; and (4) Matrix elimination technique for complex samples. (See also W88-08398) (Lantz-PTT)

NATIONAL SURFACE WATER SURVEY, WESTERN LAKE SURVEY (PHASE I - SYN-OPTIC CHEMISTRY): ANALYTICAL METH-ODS MANUAL, Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
H. B. Kerfoot, and M. L. Faber.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-234928.
Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA/600/8-87/038, August 1987. 101 p, 6 fig. 9 tab, 43 ref, append. EPA Contract No. 68-03-3249.

Descriptors: *Water analysis, *Water quality, *Lakes, *Chemical analysis, *Manuals, Acid rain, Water chemistry, Streams, Monitoring, Nitrates, Conductance, Metals, Sulfates, Color, Turbidity, Hydrogen ion concentration, Phosphorus.

This manual is a supplement to the Analytical Methods Manual for the Eastern Lake Survey Phase I, and provides a general description of the analytical methods that are used by the field laboratories and by the analytical laboratories; a detailed description of the analytical methods appears in the 'Eastern Lake Survey' publication. The supplement also describes new and modified sample processing procedures that were developed specifically for the West. Both publications are parts of the National Surface Water Survey component of the National Acid Precipitation Assessment Program, designed to evaluate the present water chemistry of lakes and streams, to determine the status of certain biotic resources, and to select regionally representative surface waters for a longregionally representative surface waters for a long-term monitoring program that will study changes in aquatic resources. To meet EPA requirements, the data collection for the survey must ensure that the resulting data: (1) are of a known quality; (2) are suitable for the intended purpose; and (3) are consistent and comparable. For these reasons, all analysts participating in the survey must use the

same reliable, detailed analytical methods. Field and/or laboratory methods described include: de-termination of dissolved inorganic carbon, pH, tur-bidity, color, chloride, nitrate, sulfate, total phos-phorus, dissolved metals, and conductance. (Lantz-PTT) W88-08423

NATIONAL DIOXIN STUDY, TIER 4 · COM-BUSTION SOURCES: FINAL TEST REPORT -SITE 1, SEWAGE SLUDGE INCINERATOR SSI

- A, Radian Corp., Research Triangle Park, NC. For primary bibliographic entry see Field 5E. W88-08427

BACTERIA ATTACHED TO GRANULAR ACTI-VATED CARBON IN DRINKING WATER, Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab. For primary bibliographic entry see Field 5F. W88-08430

SOLVING HAZARDOUS WASTE PROBLEMS: LEARNING FROM DIOXINS. International Technology Corp., Marinez, CA. For primary bibliographic entry see Field 5E.

EXPERIMENTAL AND CALCULATED PHYSICAL CONSTANTS FOR 2,3,7,8-TETRACHLOR-ODIBENZO-P-DIOXIN,

ODIBENZO-P-DIOXIN,
Syntex (USA), Inc., Palo Alto, CA.
L. Marple, R. Brunck, B. Berridge, and L. Throop.
IN: Solving Hazardous Waste Problems: Learning
from Dioxins. American Chemical Society, Washington, DC. 1987. p 105-113, 1 fig, 9 tab, 16 ref.

Descriptors: *Dioxins, *Physical properties, *Solubility, *Solubility coefficient, *Soil contamination, *Measuring instruments, Physiochemical properties, Chemical properties, Data acquisition.

The measurement of water solubility, water-octa-nol and water-soil partition coefficients for 2,3,7,8-tetrachlorodibenzodioxin presented several unique challenges. Novel experimental methods and data are reported for these physical constants. In some cases, experimental data is at odds with earlier published values. Comprehensive comparison of all available estimated, calculated, and experimental data are presented. The new values impact the calculation of the mobility of dioxin in soil, as well as other distribution properties. (See also W88-08431) (Author's abstract)

SULFUR, HALOGENS, AND HEAVY METALS IN URBAN SUMMER RAINFALL, McMaster Univ., Hamilton (Ontario). For primary bibliographic entry see Field 5B. W88-08460

FACTORS AFFECTING NOX PRODUCTION DURING CHAR OXIDATION, Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering. For primary bibliographic entry see Field 5B. W88-08468

CHEMICAL ANALYSIS OF HYDROCARBON CONTENT IN WATER, Norsk Inst. for Vannforskning, Oslo. For primary bibliographic entry see Field 5B. W88-08483

ION-CHROMATOGRAPHIC MEASURE-MENTS OF AMMONIUM, FLUORIDE, ACE-TATE, FORMATE AND METHANESULPHON-ATE IONS AT VERY LOW LEVELS IN ANT-

Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France). l'Environnement, Saint-Martin d'Heres C. Saigne, S. Kirchner, and M. Legrand.

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Analytica Chimica Acta ACACAM, Vol. 203, No. 1, p 11-21, December 1, 1987. 5 fig, 3 tab, 13 ref.

Descriptors: *Pollutant identification, *Antarctica, *Ice, *Chemistry of precipitation, *Chromatography, *Ions, *Pollutants, *Ammonium, *Fluoride, *Acetate, *Formate, *Methanesulfonate, Contamination of the contaminatio nation, Ion Chromatography

Ion chromatography is used to determine the con-centrations of organic (formate, acetate and meth-anesulphonate) and inorganic (fluoride and to the ammonium) ions present in Antarctic ice at less than 10 minus 9 g per g levels. With suitable columns, the simultaneous measurement of these ions requires only 6 min. A sample volume of 5 ml is sufficient to reach the 10 to the minus 10 g per g level. The determination of such low concentralevel. The determination of such low concentra tions requires stringent contamination-free tech-niques. For formate and acetate, the samples should never come into contact with plastics. Except for methanesulphonate, all the ions studied except for methanesuphonate, all the ions studied can be produced by dissolution of the various gaseous compounds present in a polluted atmos-phere. Therefore a glass device with pure nitrogen circulation was designed for air-free melting of samples. To prevent possible biological activity on organic matter, samples were analyzed immediate-ly after melting. Measurements of ammonium ion ly after menting. Advantagements of animonatin for in these Antarctic ice samples demonstrate that the problem of contamination by surrounding ammo-nia was not completely eliminated in previous stud-ies. The serious contamination problems encountered, particularly for carboxylic acids, cast doubt on some earlier results for remote areas. (Author's

CLEAN-UP OF ENVIRONMENTAL SAMPLES BY HIGH-PERFORMANCE LIQUID CHRO-MATOGRAPHY FOR ANALYSIS OF ORGAN-OCHLORINE COMPOUNDS BY GAS CHRO-MATOGRAPHY WITH ELECTRON-CAPTURE DETECTION

Kiel Univ. (Germany, F.R.). Inst. fuer Meeres-

G. Petrick, D. E. Schulz, and J. C. Duinker. Journal of Chromatography JOCRAM, Vol. 435, No. 1, p 241-248, January 1, 1988. 3 fig, 2 tab, 13

Descriptors: *Pollutant identification, *Sample preparation, *Polychlorinated biphenyls, *DDT, *Organochlorine compounds, *Liquid chromatog-the state of the stat raphy, *Hexachlorocyclohexanes, *Pesticides, *Electron capture, *Gas chromatography, Water

Electron-capture detection (ECD), in combination with gas chromatographic techniques, allow the quantitative and qualitative determination of orquantitative and qualitative determination of organochlorine compounds (OCs), such as polychlorinated biphenyls, and DDTs, even at extremely low concentrations. During the extraction of environmental samples, for the determination of levels of OCs, other organic compounds (aliphatics and polycyclic aromatic hydrocarbons (PAHs)) are contents of the content of the c polycyche aromatic hydrocarbons (PAHs)) are co-extracted into the organic solvent and may inter-fere seriously with the determination of OCs. A simple high-performance liquid chromatography (HPLC) method is described to remove aliphatics and PAHs from a n-hexane extract of an environ-mental sample, which can then be analyzed for OCs. With experimental solutions, clear-cut HPLC fractions were obtained using n-pentane (0-11 ml), 20% dichloromethane in n-pentane (11.0 to 15.0 ml), and 100% dichloromethane (from 15.0 ml onwards). Recoveries of all compounds investigatof wards, resolveres of an compound in investigation of week per long. The environmental samples were treated in the same way as the experimental mixtures. The various classes were found in the same fractions. This method has been shown to work conveniently for sample types that typically have very high concentrations of interfering com-pounds. The OCs were present in the sub ng/g range. (Roseman-PTT) W88-08554

DETERMINATION OF ORGANOPHOS-PHORUS PESTICIDES IN APPLES AND WATER BY GAS-LIQUID CHROMATOGRA-DETERMINATION

PHY WITH ELECTRON-CAPTURE DETEC-

TION,
Higher Inst. of Food Industry, Plovdiv (Bulgaria).
A. Neicheva, E. Kovacheva, and G. Marudov.
Journal of Chromatography JOCRAM, Vol. 435,
No. 1, p 249-253, January 1, 1988. 1 fig., 2 tab., 11

Descriptors: *Pollutant identification, *Pesticides, *Organophosphorus compounds, *Electron cap-ture gas chromatography, *Apple, Chromatogra-phy, Water Pollution, Pollutants, Crops, Foods.

Suitable conditions for a rapid and accurate gas chromatographic analysis of plant products and water for the determination of certain organophoswater for the determination of certain organophosphorus pesticides widely applied to crops in Bulgaria are presented. Several liquid phases (3% OV-17, 3% SE-30, and 5% QF-1 plus 2.5% DC-200) were tested for the determination of eight pesticides: diazinon, dimethoate, pyrimiphos-methyl, chlorpyriphos, tetrachlorvinphos, phozalone, pyracphos, and the organochlorine fenarimol in apples. The most polar phase examined (3% OV-17, 150 cm by 2 mm column) proved to be the most suitable for rapid simultaneous identification of the eight pesticides at 220 C. For improved separation and quantification, an isothermal analysis at 200 C is suggested for diazinon, dimethoate, pyrimiphos-methyl, chloropyriphos, and tetrachlorvinphos, and at 220 C for the remaining compounds. (Roseman-PTT)

EVALUATION OF THE ANDERSON BAIRD-PARKER DIRECT PLATING METHOD FOR ENUMERATING ESCHERICHIA COLI IN WATER.

WATER, Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology. A. H. Havelaar, and M. Durning. Journal of Applied Bacteriology JABAA4, Vol. 64, No. 1, p 89-98. January 1988. 10 tab, 15 ref.

Descriptors: *Escherichia coli, *Pollutant identification, *Bacterial Analysis, Contamination, Direct plating, Bacteria, Fecal pollution, Membrane filtration, Water pollution.

The direct plating method for enumerating Escherichia coli in food was adapted for water analysis by membrane filtration and a standardized protocol was described. The direct plating method was found to give equal or better recoveries of E. coli than a membrane filtration method using 0.1% sodium lauryl sulfate agar; the repeatability of the direct plating method was markedly better. The necest practing method was markedly better. The necessity to transfer membranes from the non-selective medium tryptone soy agar to the selective medium tryptone bile agar after pre incubation for 4 h was considered disadvantageous for practical purposes. A double-layer method, where the membrane layer is placed on a layer of tryptone conpurposes. A double-layer method, where the membrane layer is placed on a layer of tryptone soy agar poured over tryptone bile agar, with incubation in an incubator that automatically switches from 37 to 44 C after 4 hours, was found to be an acceptable alternative. Recovery of E. coli and inhibition of competitive flora were equal or only slightly less than for the standard direct plating method. (Author's abstract)

W88-08557

REDUCTION IN ORGANIC EFFLUENT STATIC ACUTE TOXICITY TO FATHEAD MINNOWS BY VARIOUS AERATION TECH-NIQUES.

Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Biology.

For primary bibliographic entry see Field 5G. W88-08564

GEOSTATISTICS APPLIED TO GROUNDWAT-GEUSTATISTICS APPLIED TO GROUNDWAT-FER CONTAMINATION. I: METHODOLOGY, South Florida Water Management District, West Palm Beach. Dept. of Resource Management. R. M. Cooper, and J. D. Istok. Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 270-286, April 1988. 3 fig, 21 ref.

Descriptors: *Geostatistics, *Mapping, *Ground-water, *Groundwater pollution, *Waste disposal, *Contamination, *Statistics, *Statistical analysis, *Pollutants, Water pollution, Mathematical studies,

This paper presents an introduction for the nonspecialist to the use of geostatistics to estimate and map contaminant concentrations and estimation errors in a groundwater plume from a set of measerrors in a groundwater plume from a set of meas-ured contaminant concentrations. The paper begins with a brief review of the essential elements of goostatistical theory. The four steps of geostatisti-cal analysis, with special emphasis on the technique known as point kirging, are described. This proce-dure can be used to obtain the best (i.e., the mini-sure stricture for the set of the settinated mum estimation error), linear (i.e., the estimated concentration at an unmeasured point is given by a linear combination of nearby measured concentra-tions), unbiased estimate, and the estimation error for any point within the plume. These point values can then be mapped (i.e., contours of equal values of expected conta minant concentration and estimation error can be drawn), e.g., to display the extent and severity of groundwater contamination at a site. (See also W88-08570) (Author's abstract) W88-08569

GEOSTATISTICS APPLIED TO GROUNDWAT-ER CONTAMINATION. II: APPLICATION, South Florida Water Management District, Palm Beach. Dept. of Resource Management. R. M. Cooper, and J. D. Istok.

Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p , April 1988. 5 fig, 5 tab, 8 ref.

*Geostatistics. *Groundwater, Descriptors: "Groundwater pollution, "Waste disposal, "Industrial waste, "Waste dumps, "Statistical analysis, "Statistics, "Pollutants, "Contamination, Boron, Barium, Iron, Zinc, Manganese, Mathematical studies, Geostatistics, Water pollution, Volatile organics,

This paper presents an application of the procedures developed in the first paper in this series to measured values of groundwater contaminants at the Chem-Dyne toxic waste site located in Hamilton, Ohio. Six contaminants were studied: boron, barium, iron, manganese, zinc, and total volatile organic carbon. Experimental semivariograms were computed for each contaminant and were fitted by combinations of pure nugget effect and linear and spherical semivariogram models. Point kriging was performed on the log-transformed contaminant densities and maps of the estimated contaminant densities and the kriging variances were drawn. (See also W88-08569) (Author's ab-W88-08570

ODORS FROM DISSOLVED AIR FLOTATION

National Univ. of Singapore. Dept. of Civil Engineering. For primary bibliographic entry see Field 5D. W88-08578

IMPROVED MICROCOSM DESIGN FOR PER-FORMING RESERVOIR WATER QUALITY IN-VESTIGATIONS,

Nevada Univ., Reno. Dept. of Civil Engineering. R. J. Watts, and R. H. French. Journal of Environmental Engineering JOEDDU, Vol. 114, No. 2, p 460-464, April 1988. 2 fig, 13 ref. U.S. EPA Grant R811124-01.

Descriptors: *Water quality, *Reservoirs, *Microcosms, *Model studies, *Trophic level, Design criteria, Lahontan reservoir, Nevada.

A strong and easily assembled microcosm system is described that has been used during field studies on Lahontan Reservoir, Nevada, to calibrate dynamic water quality models. Microcosms were constructed of 0.0152 cm (6 mil) clear polyethylene plastic. The material was heat sealed to form a cylinder 0.776 m in diameter. The cylinders were supported by circular aluminum bands 0.76 m in diameter.

Identification Of Pollutants-Group 5A

The bands were constructed of welded alumin The bands were constructed of welded aluminum strips. The microcosms were used for two field studies on Lahontan Reservoir, Nevada. They were used for the first 11-day experiment, removed from the water, washed with high-pressure water sprays and brushes, and then used for a second 11-day experiment. Most of the microcosms were taken from the water undamaged. For 16 microcosms, only 2 small (2 cm long) tears were found on inspection after the experiments. (Roseman-PTT) W88-08581

BIOINDICATION BY MACROPHYTES - CAN MACROPHYTES INDICATE SAPROBITY (BIOINDIKATION DURCH MAKROPHYTEN -INDIZIEREN MAKROPHYTEN SAPROBIE), Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).

Bayerisches Laucesami urer wasserwirschat, Munich (Germany, F.R.). U. Schmedtje, and F. Kohmann. Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 3, p 455-469, May 1987. 2 fig, 4 tab, 22 ref.

Descriptors: *Saprobity, *Analytical methods, *Water pollution effects, *Limnology, *Macrophytes, *Bioindicators, *Water quality, Trophic level, Macroinvertebrates, Food chains, Aquatic habitats, Rivers, Germany, Bavaria.

Water quality assessment on the basis of the sa-probiensystem' using macroinvertebrates versus macrophytes as indicators of pollution was com-pared. Relative abundances of macroinvertebrates and macrophytes were determined at twelve sam-pling stations of the river system Moosach (Upper Bungia) and a sanrobic and macrophytic index. Bavaria) and a saprobic and macrophytic index. The indices show similar results. Existing differ-The indices show similar results. Existing differences are due to different reaction times to changes in the degree of pollution. Although macrophytes may be indicators of pollution, they are not indicators of sprobity. Only organisms taking part in the destruction of organic matter or the following chain of consumption are actors and therefore indicators of saprobity. Macrophytes are primary producers and can only indicate the level of trophy. (Author's abstract)
W88-08591

BIOLOGICAL SURVEILLANCE OF WATER QUALITY: 3. THE INFLUENCE OF ORGANIC ENRICHMENT ON THE MACROINVERTEBRATE FAUNA OF SMALL CHALK STREAMS, BRATE FAUNA OF SMALL CHALK STREAMS, Freshwater Biological Association, Wareham (England). River Lab. L. C. V. Pinder, and I. S. Farr. Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 4, p 619-637, June 1987. 5 fig, 7 tab, 11 ref.

Descriptors: *River Frome, *Pollution index, *Species diversity, *Bioindicators, *Macroinverte-brates, *Limnology, *Water quality, Chemical analysis, Effluents, Comparison studies, Aquatic habitats, Water chemistry, Wastewater, Rivers, Streams, United Kingdom, Correlation analysis.

Macroinvertebrate, and water chemistry, samples were obtained from sites known to be influenced by organic effluents. Macroinvertebrates data were used to calculate 2 pollution indices, the NWC Score and the Chandler Score, together with their average score per taxon (ASPT), and 2 diversity indices, the Shannon Weaver, and the Simpson. Comparisons are made between the various indicompanished are inlade detected the various inti-ces, in relation to the order in which they ranked the various sites and in the degree to which their values were correlated with more direct measures of water quality. The NWC (ASPT) is regarded as the most sensitive index of water quality, within the range of conditions which was encountered, but is more informative when considered together with the total NWC Score. (See also W88-08588) (Author's abstract) W88-08595

THREAT TO THE NEW YORK CITY WATER SUPPLY - PLUTONIUM,
Department of Energy, New York. Environmental

Measurements Lab. For primary bibliographic entry see Field 4C. W88-08605 ROUTINE DETERMINATION OF PRINCIPAL GAMMA EMITTING RADIONUCLIDES IN MUDS AND SILTS FROM THE RIBBLE ESTU-

ARY, British Nuclear Fuels Ltd., Preston (England).

British Nuclear Fuels Ltd., Freston (Engiand). Springfield Works. A. A. J. Aldridge, and S. T. Napier. Science of the Total Environment STENDL, Vol. 70, p 119-129, March 1988. 1 fig. 2 tab, 4 ref.

Descriptors: "Monitoring, "Radioactive wastes, "Gamma radiation, "River Ribble, "Estuaries, "Spectrophotometry, "Spectroscopy, Nuclear powerplants, Analytical methods, Measuring instruments, Performance evaluation, Effluents, Radioactivity, England.

BNFL Springfields Works make authorized discharges of liquid radioactive effluent into the River Ribble estuary. In order to monitor the effect of these discharges MAFF require that mud samples taken four times per year from the estuary are analyzed for principal gamma emitters. A routine procedure has been developed for the preparation of samples and for their examination by gamma spectrometry. The investigative work which led to the development of this procedure and also the way in which control samples are used to monitor the method performance are described. Some typical results are presented and compared with those cal results are presented and compared with the reported by other analysts who have examined Ribble estuary muds. (Author's abstract)

DETERMINATION OF TECHNETIUM-99 IN THE BROWN MARINE ALGA FUCUS SPIRALIS COLLECTED ALONG THE BELGIAN

Centre d'Etude de l'Energie Nucleaire, Mol (Bel-

C. Hurtgen, G. Koch, D. van der Ben, and S. Bonotto.

Bonotto. Science of the Total Environment STENDL, Vol. 70, p 131-149, March 1988. 10 fig, 1 tab, 18 ref. Contract CCE B16-0049-B Belgian Ministry of Labour (BTK Project No. 20516.

Descriptors: *Bioindicators, *Radioactive wastes, *Monitoring, *Technetium, *Marine algae, *Belgium, Analytical methods, Tissue analysis, Path of pollutants, Isotope studies, Bioaccumulation, Coastal waters, Aquatic plants, Algae, Radioactiv-

aty.

The brown alga Fucus spiralis (Fucales) grows along the Belgian coast in sufficient amount to permit regular sampling. The algae were collected at four different places (Nieuwpoort, Oostende, Blankenberge and Zeebrugge) from March 1985 to February 1986. The method used to determine 99Tc and the subsequent results are reported. The concentration of 99Tc (Bq/kg dry weight) in whole plants was found to increase as a function of time. In addition, analyses on separated parts have revealed that, generally, apical fragments possess a lower content of 99Tc than the middle and basal ones. These results suggest that the old tissues of Fucus spiralis, present in middle and basal fragments, have integrated technetium uptake over a period of few years, in contrast to the young ones of the apices, which have probably fixed this radio-nuclide only during a short period of time. The concentrations factors (CFs), evaluated on the basis of 3 mRq 99Tc/L seawater, varied from 8,000 to 36,000 in whole plants, reaching however 51,000 in middle fragments. These figures are of the same order of magnitude than those reported for related in middle fragments. These figures are of the same order of magnitude than those reported for related species of Fucus collected along the French coast of the Channel. It adds further evidence that Fucus spiralis may be used as a bioindicator for 99Tc contamination of coastal waters. (Author's ab-

METHODOLOGICAL APPROACH TO THE EVALUATION OF DIFFUSION COEFFICIENTS OF RADIONUCLIDES IN MARINE

CIENTS OF RADIONUCLIDES IN MARKINE COASTAL SEDIMENTS, Pavia Univ. (Italy). Dipt. di Chimica Generale. A. Berzero, P. A. Borroni, S. Meloni, W. Martinotti, and G. Queirazza.

Science of the Total Environment STENDL, Vol. 70, p 151-177, March 1988. 7 fig. 5 tab, 8 ref.

Descriptors: *Path of pollutants, *Diffusion coefficients, *Radionuclides, *Sediments, Isotope studies, Solute transport, Analytical methods, Sediment-water interfaces, Statistical methods, Mathematical methods, Mathemat matical studies, Performance evaluation, Radioac-

The migration of radionuclides from seawater to bottom sediments may induce accumulation of ra-dioactivity in the bottom. Different mechanisms contribute to the transport of radionuclide solutes through pore water and across the water-sediment interface. The diffusive contribution to radioactivity transport was evaluated. Diffusion coefficients for a number of radionuclides in marine coastal sediments, collected in the Mediterranean sea, were measured in an experimental arrangement the more similar to natural stationary seawater-bottom sediment conditions. Measured diffusion coeffisecument conductors. Measured armson coemicients for the different radionuclides were statistically treated to search similarities and/or meaningful differences. Results indicate that the experimental set-up is quite important to obtain reliable diffusion coefficients. (Author's abstract)

RADIONUCLIDES IN COASTAL AND ESTUA-RINE SEDIMENTS FROM WIRRAL AND LAN-CASHIRE,

CASHIRE, Liverpool Univ. (England). Dept. of Geography. P. J. P. Bonnett, P. G. Appleby, and F. Oldfield. Science of the Total Environment STENDL, Vol. 70, p 215-236, March 1988. 6 fig. 8 tab, 11 ref.

Descriptors: *Radionuclides, *Sediments, *Gamma radiation, *Isotope studies, *Estuaries, *Coastal waters, Analytical methods, Prediction, Radioactivity. England. Sediment cores. Particle size.

Radionuclide levels in surface sediments from estuarine and intertidal areas of the Wirral and Lancaarine and intertidal areas of the Wirral and Lanca-shire coastlines were measured by gamma assay, and compared with values on the Cumbrian coast close to Sellafield (England). The relationship be-tween particle size and activity is investigated, as well as the association with a number of magnetic mineral parameters in order to establish whether such measurements are of use in predicting vari-ations in activity related to particle size composi-tion. Down-profile variations of 137Cs, 134Cs and 241Am are determined for a number of estuarine cores and are used to assess net accumulation rates. cores and are used to assess net accumulation rates. Cores and are used to assess her accumulation rates. Isotope inventories and calculated in order to assess the extent to which radionuclides from Sel-lafield have been concentrated in estuarine sedi-ments. (Author's abstract)

NEUTRON ACTIVATION ANALYSIS OF NAT-URAL WATER SAMPLES USING CF-252 SOURCES,

Chiang Mai Univ. (Thailand). Dept. of Chemistry. O.-A. Na Lamphun, S. Moebius, and C. Keller. Science of the Total Environment STENDL, Vol. 70, p 415-431, March 1988. 2 fig. 5 tab, 20 ref.

Descriptors: *Trace elements, *Neutron activation analysis, *Natural waters, Californium, Analytical methods, Measuring instruments, Detection limits, Performance evaluation, Radioactivity, Aluminum, Arsenic, Chlorine, Potassium, Magnesium, Manganese, Sodium, Strontium, Titatium, Uranium, Vanadium, Zinc, Comparison studies.

Instrumental neutron activation analysis using Cf-252 sources with a NaI- and a high resolution Ge(Li)-detectors was applied to elemental analysis of trace elements in different river water samples. of trace elements in different river water samples. The minimum detection limits for some common elements such as Al, As, Cl, K, Mg, Mn, Na, Sr, Ti, U, V and Zn of both detectors were determined and verified with standard solutions. Both suspended particulate matter and liquid fraction from water samples were investigated. Comparison of data using different preconcentration methods including evaporation, adsorption and coprecipitation with some organic and inorganic reagents and

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adsorption on activated charcoal for the specified elements is presented. The percent efficiencies for coprecipitation on various precipitates are shown. uthor's abstract) W88-08611

EFFECTS OF HEAVY METALS ON THE FRESHWATER SNAIL, SEMISULCOSPIRA BENSONI, IN A CLOSED MINING AREA, (IN

Nagasaki Prefecture Inst. of Health Science and Environmental Science (Japan). For primary bibliographic entry see Field 5C. W88-08636

COMPREHENSIVE LOOK AT WATER TREAT-

For primar W88-08655 ary bibliographic entry see Field 5F.

BIOMONITORING OF OIL SPILL IN A BOREAL ARCHIPELAGO BY XENOBIOTIC BIOTRANSFORMATION IN PERCH (PERCA

Kuopio Univ. (Finland). Dept. of Physiology. For primary bibliographic entry see Field 5C. W88-08672

DETERMINATION OF ATRAZINE RESIDUES IN WATER AND SOIL BY ENZYME IMMUN-

IN WALES OF COMMENT OF THE STREET OF T

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 647-654, May 1988. 6 tab, 11 ref.

Descriptors: *Pollutant identification, *Water analysis, *Immunoassay, *Soil analysis, *Herbicides, *Atrazine, Pesticides.

A method for determination of atrazine in water and soil is useful for screening with fairly good accuracy compared with high performance liquid chromatography. Since the antibody exhibits cross-reactivity, other triazine herbicides interfere. Atrazine antiserum was prepared by derivatizing atra-zine antiserum was prepared by derivatizing atra-zine at the 2-chloro position and covalently conju-gating it to bovine gamma globulin with a final molar ratio of hapten to globulin of 30:1. Antise-rum was prepared in rabbits. Antibodies to atrazine were coated to the walls of polystyrene test tubes, and horseradish peroxidase was bound to the atrawere coaled to the walls of polystyrene test tubes, and horseradish peroxidase was bound to the atrazine. The substrate and chromogen were stabilized, buffer preparations of hydrogen peroxide and teramethylbenzidine, respectively. Water analysis was conducted by adding 100 microliter of sample to a test tube followed by 160 microliters of atrazine enzyme conjugate. After a 5-min incubation, the unreacted material was rinsed away with water. The hydrogen peroxide was added, followed by 160 microliters of tetramethylbenzidine. After 5 min of incubation the reaction was stopped with sulfuric acid and the yellow color measured After 5 min of incubation the reaction was stopped with sulfuric acid and the yellow color measured with a photometer. The soil analysis procedure was similar except for an added water/solvent extraction step. The immunoassay showed a linear relationship from 0.5 to 10 ng/ml atrazine. Dilution was required above that concentration. (Cassar-TT) W88-08680

INTERACTION OF ORGANIC SOLVENTS WITH THE GREEN ALGAE CHLORELLA PYRENOIDOSA,

Nova Scotia Agricultural Coll., Truro. Environ-mental Microbiology Lab. G. W. Stratton, and T. M. Smith.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 736-742, May 1988. 3 tab, 15 ref.

Descriptors: *Algae, *Solvents, *Bioassay, *Toxicity, *Pesticides, Chlorella, Assay, Organic solvents, Atrazine, Acetone, Ethanol, Methanol, Hexane, Dimethyl sulfoxide, Dimethyl formamide.

The toxicity of solvents commonly used in bioassays was tested using the green algae Chlorella pyrenoidosa. The EC50 values were as follows: acctone, 3.02; ethanol, 1.18; methanol, 3.60, hexane, 2.6c; dimethyl sulfoxide, 2.01; and dimethyl formamide, 0.94. These data indicate that dimethyl formamide and ethanol would be unsuitable for toxicity bioassays; methanol would be the least toxic solvent. In studies of solvent-atrazine interaction, no antagonism was seen at ethanol concentrations of 0.1%. At ethanol concentrations of 0.5 to 0.30 and atrazine concentrations of 0.05 to 0.30 ppm, the magnitude of interaction difference in The toxicity of solvents commonly used in bioas 3.0% and atrazine concentrations of 0.05 to 0.30 ppm, the magnitude of interaction (difference in net pesticide effect between the additive solvent range and the highest solvent level used) ranged from 15% to 60%, with the magnitude increasing with higher atrazine concentrations. Acetone and atrazine also interacted antagonistically toward algal growth, but only at solvent levels >4.0-5.0%. The only exceptions were at atrazine concentrations of 0.05 ppm, where acetone interacted additively at all solvent levels assayed, and 0.08 ppm, where acetone interacted antagonistically above 1.0% (Cassar-PTT) W88-08684

SAMPLING AND GC-FID, GC/MS ANALYSIS OF PETROLEUM HYDROCARBONS IN THE OCEAN SURFACE MICROLAYER OF RICH-ARDS BAY, SOUTH AFRICA,

National Inst. for Water Research, Pretoria (South

A. C. Butler, and R. R. Sibbald. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 1, p 27-42, July 1987. 8 fig, 2 tab, 39

Descriptors: *Oil pollution, *Coastal waters, *Pol-lutant identification, *Chemical analysis, *Gas chromatography, *Mass spectrometry, *Sampling, *On-site data collections, *Hydrocarbons, Air-water interfaces, Aliphatic hydrocarbons, Aromat-ic compounds, Marine environment, Richards Bay, South Africa, Surveys, Computers.

In view of the demonstrated concentration of hydrophobic pollutants at the air/water interface and their expected deleterious effects on the associated neuston, surface microlayer sampling with a Teflon disc was introduced as part of a coastal oil Teflon disc was introduced as part of a coastal oil pollution survey. Differentiation of the petroleum assemblages comprising the samples was demonstrated, using gas chromatography with flame-ionization detection (GC-FID) and gas chromatography/mass spectrometry (GC/MS) with computer-reconstructed mass fragmentograms. The GC-FID technique provides parameters such as the carbon-number preference index, which distinguishes biogenic from petrogenic sublemes while the relative genic from petrogenic n-alkanes, while the relative abundances of ions characteristic of steranes and abundances of ions characteristic of steranes and give further evidence of the petrogenic origin of the hydrocarbon assemblages found. Levels of petroleum hydrocarbons found were uniformly higher (expressed as micrograms/square m) than those reported previously, where sampling techniques differed from the present one in taking a finite volume of surface water for analysis. (Author's abstract) thor's abstract) W88-08710

MEASUREMENT OF VOLATILE FATTY ACIDS IN PORE WATER FROM MARINE

ACIDS IN PORE WATER FROM MARINE SEDIMENTS BY HPLC, Scottish Marine Biological Association, Oban. I. Mueller-Harvey, and R. J. Parkes. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 5, p 567-579, November 1987. 4 fig, 4 to 26. tab. 36 ref.

Descriptors: *Fate of pollutants, *Pollutant identification, *Volatile acids, *Fatty acids, *Interstitial water, *Sediments, *Marine Sediments, *Chromatography, *Chemical analysis, Organic matter, De-composing organic matter, Enrichment, Organic compounds, Organic acids, Amino acids, Anaero-bic conditions, Wastes, Organic wastes, United

Lower-molecular-weight volatile fatty acids are important intermediates in the anaerobic degrada-

tion of organic matter in marine sediments. The analysis of these compounds at the low in situ concentrations, however, still presents difficulties. A new derivatization procedure for the analysis of these compounds, coupled with high-performance liquid chromatography (HPLC), has been modified for the analysis of volatile fatty acids in marine pore water to cover a linear calibration range from 0.5 micromoles to 10 millimoles. The modifications resulted in the detection of concentrations 40 times lower than in the original method and in good lower than in the original method and in good recoveries of fatty-acid standards added to pore water (mean 101%). This modified procedure was then used to analyze fatty acids in pore water from sediments along a gradient of organic enrichment. The relative ratios of the individual acids were 1 to 0.1 to 0.02 to 0.01 to 0.02 to 0.01 for acetate, 0.1 to 0.02 to 0.01 to 0.02 to 0.01 for accesse, propionate, n-butyrate, 2-methylbutyrate, iso-valerate, and n-valerate. There was a tendency for the concentration of the more-reduced acids (propionate and n-butyrate) to increase as organic enrichnate and n-butyrate) to increase as organic enrich-ment increased. Several fatty acids were found that have not commonly been reported in marine pore water. These include 2-methylbutyrate, which is a specific anaerobic degradation product of iso-leucine, which has not been previously found in marine pore water. (Author's abstract)
W88-08736

EFFECT OF LOW PH AND ALUMINUM ON THE OLFACTORY ORGAN OF RAINBOW TROUT, SALMO GAIRDNERI,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst. For primary bibliographic entry see Field 5C. W88-08785

DETERMINATION OF POLYCYCLIC AROMATIC COMPOUNDS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY WITH SIMULTANEOUS MASS SPECTROPHOTOMETRY AND ULTRAVIOLET DIODE ARRAY DETECTION,

National Research Council of Canada, Halifax (Nova Scotia). Atlantic Research Lab. M. A. Quilliam, and P. G. Sim.

Journal of Chromatographic Science JCHSBZ, Vol. 26, No. 4, p 160-167, April 1988. 5 fig, 1 tab,

Descriptors: *High-performance liquid chromatography, *Water analysis, *Chemical analysis, *Marine sediments, *Pollutant identification, *Hydrocarbons, *Chromatography, Polycyclic aromatic compounds, Ultraviolet diode array detection, Mass spectrophotometry.

The analysis of polycyclic aromatic hydrocarbons (PACs) in the environment is of considerable im-(PACs) in the environment is of considerable importance due to increasing concern over the mutagenicity and carcinogenicity of many of these compounds. A major concern in the determination of PACs in environmental samples is the extreme complexity of the extracts, even after extensive fractionation. The combination of high-performance liquid chromatography (HPLC) with simultaneous mass spectrophotometry (MS) and ultraviolet diode array detection (DAD) was investigated and found to be a powerful tool for the identification and quantification of such species. HPLC allows the selective separation of a wide variety of PACs, including thermally labite and high molecular weight compounds. Electron ionization MS with the moving belt interface provides high sensitivity and selectivity as well as structural informawith the moving belt interface provides high sensitivity and selectivity as well as structural information such as molecular weight, functional groups, and elemental composition. The diode array deterior helps to differentiate isomeric structures and confirm compound identity. The application of the C/DAD/MS technique to the determination of PACs in a marine sediment reference material is presented. (Miller-PTT)
W88-08807

STUDIES OF THE TRICHOPTERA OF THE VOGELSBERG AREA: 2. EFFECTS OF POLLUTION IN RUNNING WATERS (UNTERSUCHUNGEN UBER DIE TRICHOPTERA DES **VOGELSBERGES: 2. AUSWIRKUNGEN ANTH-**

Identification Of Pollutants-Group 5A

ROPOGENER VERUNREINIGUNGEN DER FLIESSGEWASSER),

Giessen Univ. (Germany, F.R.). Inst. fuer Allgemeine und Spezielle Zoologie.
R. Burkhardt.

Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 1, p 107-119, November 1987. 1 fig, 2 tab, 24 ref.

Descriptors: *Running waters, *Bioindicators, *Caddisflies, *Water pollution effects, Germany, Pollutant identification.

Pollutant identification.

Saprobic tolerances of 63 running water species collected in the Vogelsberg area (Hessia, West Germany) are listed. Most of the Trichoptera species are restricted to clean or slightly polluted reaches. In alpha, beta-mesosaprobic zones, the number of species was reduced to 60%. At sample stations classified as alpha-masosaprobic, only 25% of species were found. In polysaprobic zones caddis larvae could not live. A correlation exists between saprobic tolerance and longitudinal distribution in the streams studied. Most of the species tolerating pollution are typical for the lower regions. More than 50% of the species which prefer the upstream zones could be found at highly polluted places as well. However, caddisfiles living in the upper regions exclusively were restricted to clean or slightly polluted reaches. When the water quality class is alpha, beta-mesosaprobic, a reduction in numbers of Trichoptera species was recognized in all zones of the streams. In the lower regions, the resistant members of the typical communities remain if pollution are increases whereas in the upper region nearly all of the characteristic caddisfiles are eliminated and resistant species typical for the lower regions appear. Thus Trichoptera communities are equalized by pollution. It is concluded that caddisfiles can be used as bioindicators for the quality of waters but that there are no index organisms for heavily polluted waters. (Miller-PTT) organisms (PTT) W88-08813 ms for heavily polluted waters. (Miller-

USE OF BIOASSAY AND ASSOCIATED TESTS IN DREDGED MATERIAL AND DISPOSAL MANAGEMENT, Corps of Engineers, Vicksburg, MS. C. R. Lee, R. K. Peddicord, B. L. Folsom, and J. C. Skroesker.

G. Skogerboe. Hydrobiologia HYDRB8, Vol. 149, p 81-86, June 1987. 1 fig, 4 tab, 11 ref.

Descriptors: *Dredging, *Bioassay, *Water pollution effects, *Analytical methods, *Spoil disposal, *Land disposal, *Surface runoff, *Simulated rainfall, *Ecological effects, *Waste disposal, *Plant physiology, Path of pollutants, Heavy metals, Plants.

Plant bioassays and simulated rainfall-surface runoff tests have been developed and are being refined to assist in the evaluation of the environment impact of dredged material disposal alternatives. Plant bioassay tests have been used to give appropriate information to describe the potential for contaminant mobility from dredged material into plants colonizing wetland and upland disposal environments. Index plants have shown elevated contents of Cd, Zn, Cu, Cr and Pb when grown on contaminated dredged material placed in a terrescontents of Cd, Zn, Cu, Cr and Pb when grown on contaminated dredged material placed in a terrestrial disposal environment. Simulated rainfall-surface runoff water quality tests are being developed to determine the potential for contaminant mobility resulting from physicocchemical changes in dredged material following upland disposal. A management strategy has been developed that incorporates the above test results for a selection of environmentally acceptable dredged material disposal alternatives. (Author's abstract) W88-08863

PHYTOPLANKTON BIOASSAYS FOR EVALUATING TOXICITY OF IN SITU SEDIMENT CONTAMINANTS, Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Fisheries Research Branch. M. Munawar, and I. F. Munawar. Hydrobiologia HYDRB8, Vol. 149, p 87-105, June 1987. 12 fig, 4 tab, 40 ref.

Descriptors: *Reviews, *Sediments, *Analytical methods, *Water pollution effects, *Pollutants, *Toxicity, *Phytoplankton, *Bioassay, *Bioaccumulation, Ecological effects, Aquatic habitats, mulation, I Great Lakes

Routine bulk chemical characterization of sedi-ments does not provide useful information on toxments does not provide useful information on toxicity of sediment bound contaminants. This study reviewed and evaluated the utility of phytoplankton bioassays for evaluation of toxicity of sediment bound contaminants, including state-of-the-art techniques. Several techniques such as Algal Fractionation Bioassays, microcomputer-based toxicity testing and in situ bioassays including plankton cages have been developed and successfully applied in our research at various contaminated sites in the Great Lakes. These bioassay techniques are sensitive, rapid and inexpensive for screening contaminants. The use and application of such techniques, based on bioavailability and physiological response of micro-organisms, are essential for the detection of environmental perturbations of an ecosystem. Such an early warning system will fadetection of environmental perturbations of an ecosystem. Such an early warning system will fa-cilitate the preservation and rehabilitation of the Great Lakes. (Author's abstract) W88-08864

OLIGOCHAETE RESPIRATION AS A MEASURE OF SEDIMENT TOXICITY IN PUGET SOUND, WASHINGTON,

P. M. Chapman. Hydrobiologia HYDRB8, Vol. 155, p 249-258, December 1987. 2 fig, 3 tab, 24 ref.

Descriptors: *Sediments, *Oligochaetes, *Respira-tion, *Puget Sound, *Bioassay, *Estuaries, *Wash-ington, *Toxicity, *Water pollution effects, *Sub-lethal effects, *Population exposure, Dissolved oxygen, Reproduction, Tissue analysis, Worms.

Respiration rate measurements were conducted with the marine oligochaete Monopylephorus cuticultatus Baker and Brinkhurst to determine the sublethal toxicity of sediments collected from Puget Sound, Washington. Worms were exposed to elutriates prepared from centrifuged sediment slurries. Standard respiration rates were measured at high disorder gargen, levels for seach ward. slurries. Standard respiration rates were measured at high dissolved oxygen levels for each sample tested and were compared with control and other test results. A total of 97 sediment samples were tested; 40 samples demonstrated significant respiration effects (elevation or depression). Comparison with results of other tests conducted at the same stations or geographic locations (genotoxicity to fish cells, lethality to sensitive species, reproductive impairment tests) indicated very good agreement on broad scale toxicity patterns at different geographical areas, and that respiration measurements effectively determined sublethal toxicity of sediments. This study represents the first applicasediments. This study represents the first applica-tion of respiration measurements as a sublethal toxicity test for field-collected sediments. (Author's abstract) W88-08874

RAPID AND RELIABLE METHOD TO QUANTIFY ENVIRONMENTAL EFFECTS ON LAMINARIA BASED ON MEASUREMENTS OF

ION LEARAGE, Goeteborg Univ. (Sweden). Dept. of Botany. B. Axelsson, and L. Axelsson. Botanica Marina BOTNA7, Vol. 30, No. 1, p 55-61, January 1987. 6 fig, 2 tab, 17 ref.

Descriptors: *Water pollution effects, *Industrial wastewater, *Kelps, *Pollutant identification, *Algae, *Phaeophyta, *Heavy metals, *Surfactants, Osmotic pressure, Organic metal compounds, Mercury, Organotin compounds, Ion leak-

A method to quantify the effects of harmful environmental conditions was developed and tested on several brown seaweeds. The method was most suitable on 2 Laminaria species. These conditions included exposure of the seaweeds to heavy metal compounds surfactants, especies trease or combines. compounds, surfactants, osmotic stress or combina-tion of them. The method was based on the ability of the seaweeds to leak ions when placed in dis-tilled water. The loss of ions in both Laminaria

species increased gradually with the degree of the harmful conditions to which they were exposed and could thus be used as a measure of the extent of damage. The method was suitable for measuring combined effects of external stress. The strong effect of mercury and two organic tin compounds was demonstrated as well as the synergistic effect of two surfactants and organic mets' compounds. This method could be used to detect harmful substances in industrial waste water. (Author's abstract) stract) W88-08876

SIMPLIFIED METHODS FOR THE MICRO-BIOLOGICAL EVALUATION OF BOTTLED NATURAL MINERAL WATERS,

Consejo Superior de Invetigaciones Cientificas, Madrid (Spain). Inst. Jaime Ferran de Microbiolo-

R. Rivilla, and C. Gonzalez. Journal of Applied Bacteriology JABAA4, Vol. 64, No. 3, p 273-278, March 1988. 4 tab, 23 ref.

Descriptors: *Bottled water, *Mineral water, *Bacterial analysis, *Microbiological studies, Pseu-

The conventional methods for the microbiological examination of natural mineral water were com-pared with a simplified procedure. When indicator pates with a simplified procedure. When indicator microorganisms are present in water, they may not be detected by the simplified method. An alternative procedure, based on the detection of fecal coliforms and Pseudomonas aeruginosa is suggested as a more reliable and rapid (24 hr) method for measuring the quality of mineral waters. (Brock-PTT) PTT) W88-08895

SIMULTANEOUS MULTIELEMENTAL ANAL-YSIS OF SOME ENVIRONMENTAL AND BIO-LOGICAL SAMPLES BY INDUCTIVELY COU-PLED PLASMA ATOMIC EMISSION SPEC-

TROMETRY, Cincinnati Univ. Medical Center, OH. Dept. of

Environmental Health.
S. S. Que Hee, and J. R. Boyle.
Analytical Chemistry ANCHAM, Vol. 60, No. 10, p 1033-1042, May 15, 1988. 9 tab, 32 ref.

Descriptors: *Chemical analysis, *Water analysis, *Spectroscopy, Metals.

The Parr bomb technique is the preferred acid digestion method for multielemental analysis by simultaneous inductively coupled plasma atomic emission spectroscopy (ICP-AES) when compared with microwave and hot plate methods for many environmental and especially biological specimens. One digestion alone often did not produce quanti-One algestion alone often due not produce quanti-tative results compared with a sequential digestion scheme. The digestions were then refined to be as-similar as possible for the various substrates stud-ied. The interference of carbon on As and Se had to be corrected at > or = 3000 micrograms of C/ nd in the analysis solution, and thus the C content. had to be monitored to assess the efficiency of the digestions and to determine if interelemental correction for C presence was required. The C correction was adequate in the range 3000-10000 micrograms of C/ml. The use of modified k values was demonstrated to provide accuracy and had to be grams of Crim. The use of mounted a Value's was demonstrated to provide accuracy and had to be used for ICP-AES spectrometers where back-ground corrections were performed first for fixed channels. When used to analyze water samples, channels. When used to analyze water samples, there was no need for matrix matching and the elemental content could be determined directly as long as samples with particulate were filtered. The observed values agreed well with National Bureau of Standards values. (Brock-PTT)

FAECAL CLOSTRIDIA AND INDICATOR BACTERIA LEVELS IN AN EUTROPHIC IM-POUNDMENT,
Hydrological Research Inst., Pretoria (South

Africa)

D. P. Sartory. Water SA WASAD, Vol. 14, No. 2, p 115-117,

Group 5A—Identification Of Pollutants

April 1988.

Descriptors: *Bacterial analysis, *Water quality, *Bioindicators, *Eutrophication, Microbiological assessment, Fecal bacteria, Bioindicators, Water quality, Reservoirs, Rivers.

Fecal clostridia, fecal coliforms and fecal strepto-Fecal clostridia, fecal coliforms and fecal strepto-cocci numbers in Roodeplant Dam and two inflow-ing rivers were monitored for 8 months from Janu-ary to August 1985. Fecal clostridia occurred at mid-dam sampling stations and inflowing waters in greater numbers than fecal strepto-cocci, which occurred at greater numbers at mid-dam stations than fecal coliforms, emphasizing the difference in environmental persistence of the 3 indicator groups. Of 135 fecal clostridia isolates 105 (78%) were confirmed as Clostridium perfingens. Fecal were confirmed as Clostridium perfringens. Fecal clostridia enumeration may be a useful method in the microbiological assessment of water quality.
(Author's abstract)
W88-08910

POROUS CUP SAMPLERS: CLEANING PROCEDURES AND POTENTIAL SAMPLE BIAS FROM TRACE ELEMENT CONTAMINATION,

ences. C. L. Creasey, and S. J. Dreiss. Soil Science SOSCAK, Vol. 145, No. 2, p 93-101, February 1988. 4 fig, 1 tab, 14 ref. EPA Assistance Agreement 69-03-2967.

Descriptors: *Trace elements, *Sampling, *Water sampling, *Pollutants, *Porous cup samplers, *Cleaning, *Contamination, *Soil water, Vadose water, Trace element contamination, Leaching, Hydrogen ion concentration, Trace metals, Biased results.

Porous cup samplers are the most commonly used devices for collecting water from the vadose zone. These samplers were originally developed for studies of major cation and nutrient concentrations in agricultural soils. As their use has expanded to investigations of trace metals and other contamiinvestigations of trace metals and other contami-nants, concern has arisen about whether originally recommended cleaning procedures are appropriate for the new applications. If the samplers are not prepared adequately before installation, the porous prepared adequately before installation, the porous cup material may release contaminants into collected samples and bias study results. To address this concern, two sets of laboratory experiments were performed: (1) to examine a commonly used cleaning procedure for porous cups in the context of trace element contamination and (2) to evaluate the effectiveness and necessity of sampler cleaning under a range of pH conditions. The first experiment entailed leaching ceramic, alundum, and Teffon porous cups with four 250-ml aliquots of 1 N HCl. Analysis of the aliquots demonstrated that the widely used cleaning method proposed by Grover and Lamborn is applicable for trace element work. In the second experiment, buffered solutions at pH 4, 6, and 8 were evacuated through cleaned porous cups and pH 6 solutions were drawn through uncleaned cups. Amounts of contaminants leached from the cleaned samplers were comparable or less than those observed in the last comparable or less than those observed in the last aliquot of cleaning solution in the first experiment. Ceramic cups generally released lower contami-nant concentrations than alundum or Teflon cups. Concentrations of contaminants released from either cleaned or uncleaned cups were generally less than 10% of concentrations found in typical well-aerated soil water. Thus, cleaned or un-cleaned samplers of the types studied here will contribute significant bias only. (Author's abstract) W88-08911

TREND AND SEASONAL VARIATION OF PRECIPITATION CHEMISTRY DATA IN THE NETHERLANDS,

NETHERLANDS, Royal Netherlands Meteorological Inst., De Bilt. T. A. Buishand, G. T. Kempen, A. J. Frantzen, H. F. R. Reijnders, and A. J. VanDenEshof. Atmospheric Chemistry ATENBP, Vol. 22, No. 2, p. 339-348, February 1988. 8 fig., 1 tab., 28 ref., 3

Descriptors: *Seasonal variation, *Model studies, *Chemistry of precipitation, *Acid rain, *Path of

pollutants, *Netherlands, *Temporal distribution, *Statistical analysis, *Hydrogen ion concentration, *Regression analysis, Precipitation, Multiple re-gression model, Annual cycle, Ion, Hydronium, mmonium, Nitrates, Sulfates, Trend detectability, Bulk precipitation.

A multiple regression model is introduced to de-scribe temporal variations in precipitation chemis-try data. The model considers the effects of the try data. Ine moder considers the circles of the annual cycle, a linear trend and precipitation quantity simultaneously. The paper discusses the application of the model to concentrations and depositions of hydronium, ammonium, nitrate and sulfate for monthly bulk samples in the Netherlands for the period 1978-1984. Statistical conclusions about the period 1978-1984. Statistical conclusions about the annual cycle and the trend are hardly influenced by the choice of the dependent variable (depositions, concentrations or logarithms of concentrations). With the exception of H(+) concentrations, a large part of the temporal variations was due to precipitation-quantity effects. Significant annual cycles were found for nitrate, ammonium and sulfate. There was statistical evidence of a downward trend for sulfate and nitrate. A complex, non-linear trend was observed for H(+) plex, non-linear trend was observed for H(+) which resulted in a significant autocorrelation of the residuals from the regression equation. Much attention is paid to the detectability of trend. For ammonium, nitrate and sulfate it is possible to discriminate small systematic changes in quite short records (a mean annual change of 4-6% in a 5-year record). This is not the case for H(+), because temporal variations of this component are insufficiently explained by the systematic annual cycle and precipitation-quantity. (Author's ab-W88-08950

5B. Sources Of Pollution

MOVEMENT OF AMMONIUM NITRATE INTO UNSATURATED SOIL DURING UNSTEADY ABSORPTION,

Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology. For primary bibliographic entry see Field 2G. W88-07988

RELATIONS AMONG SULFATE, ALUMINUM, IRON, DISSOLVED ORGANIC CARBON, AND PH IN UPLAND FOREST SOILS OF NORTH-WESTERN MASSACHUSETTS, Williams Coll., Williamstown, MA. Center for En-

vironmental Studies

D. P. Dethier, S. B. Jones, T. P. Feist, and J. E.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 506-512, March-April 1988. 6 fig, 1 tab, 27 ref. DOI Agreement No. 14-08-0001-G912-05.

Descriptors: "Acid rain, "Acid deposition, "Soil chemistry, "Forest soils, "Iron, "Sulfates, "Aluminum, "Cycling nutrients, "Soil water, "Hydrology, Acidity, Water chemistry, Minerals, Streams, Massachusetts, Soil horizons, Perculation.

Selected chemical characteristics of 28 soils from upland sites in northwestern Massachusetts were examined in conjunction with a study of elemental examined in conjunction with a study of elemental cycling in northern hardwood forests. Acidic silt loam soils (Typic Dystrochrepts and Typic Haplorthods) contained large amounts of dissolved organic carbon (DOC) and soluble SO4 and Al. Chemical correlations in both Ochrepts and Orthode suscept that exchange existing of organic Chemical correlations in both Centrepts and Orthodos usagest that exchange acidity of organic matter controls pH values near 4.0 in O and A horizons, and that exchange reactions and mineral dissolution produce somewhat higher pH (4.5-5.9 in mineral horizons. The solubility of SO4 and monomeric Al at pH levels from about 3.8 to 5.5 is controlled by organic matter in O and A horizons, and by DOC, pH, and extractable Fe and AI in mineral horizons. Isotherms from three soils show that SO4 dissolved from the O and A horizons will be sorbed by the mineral soil only when concentrations exceed about 8 mg/L. Stream chemistry suggests that acidic soil solutions are neutralized and

soluble Al is sorbed as waters percolate beneath the mineral soil. (Author's abstract) W88-07999

MICROBIAL FERROUS IRON OXIDATION IN ACIDIC SOLUTION.

Carnegie Inst. of Tech., Pittsburgh, PA. Dept. of Civil Engineering.
J. R. Smith, R. G. Luthy, and A. C. Middleton.

Journal Water Pollution Control Federation JWPFAS, Vol. 60, No. 4, p 518-530, April 1988, 11 fig, 6 tab, 47 ref.

Descriptors: *Oxidation, *Biological oxidation, *Weathering, *Acidity, *Leaching, *Microbial leaching, *Mining industry, *Iron bacteria, *Sulfur bacteria, Ores, Metals, Thiobacillus ferrooxidans, Sulfide, Hydrogen ion concentration, Sulfuric acid, Yield equations, Thermodynamic, Growth rates, Growth kinetics, Sludge, Films.

Microbial ferrous iron oxidation in a dilute sulfuric acid medium at low pH was investigated. As part of a study of acidic leach solution chemistry and chemical speciation effects on metal-sulfide oxidation these studies were performed to understand the processes that accompany microbial extraction of metals from ores, and to learn of similar reactions that may occur naturally. pH values of 1.0 to 2.4 affected microbial oxidation rate very little. Microbial yield coefficients were experimentally Microbial yield coefficients were experimentally determined and agreed with predictions from thermodynamic considerations. The maximum specific growth rate coefficient and the half-velocity coefficient represented experimental data. Oxidation occurred rapidly and the minimum sludge age value was about 0.4 day. Attached film processes may be the most appropriate systems for achieving microbial oxidation of ferrous iron. (Author's abstract) stract) W88-08009

HYPOXIA AND SALINITY IN VIRGINIA ES-TUARIES,

William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science. For primary bibliographic entry see Field 2L. W88-08012

SULFUR, HALOGENS, AND HEAVY METALS IN SUMMER RAINS, CHURCHILL, MANITO-BA, CANADA,

McMaster Univ., Hamilton (Ontario). Dept. of Ge-

S. J. Vermette, and V. G. Bingham. Arctic and Alpine Research ATLPAV, Vol. 19, No. 2, p 187-193, May 1987. 4 fig, 4 tab, 9 ref.

Descriptors: *Air pollution, *Subarctic zone, *Rain, *Heavy metals, *Halogens, *Sulfur, *Path of pollutants, Zinc, Chlorine, Aluminum, Bromine, Iron, Iodine, Magnesium, Manganese, Sodium, Va-nadium, Barium, Calcium, Copper, Background levels, Power plants, Churchill, Manitoba, Canada.

Rain samples were collected during the summer of 1985 in Churchill, Manitoba. Seventeen targeted elements were determined in 13 rain events by either neutron activation analysis or inductively coupled plasma mass spectroscopy. Elemental con-centrations were found to vary with rain events dependent in part on both surface cover and air trajectory. Snow-covered lowlands (wet in late spring and summer) and a late thaw of the ice cover in the western basin of Hudson Bay are thought to restrict the availability of natural aero-sols. Al, Br, Fe, I, Mg, Mn, and V were moderate-ly enriched. The high enrichment of S, and its strong correlation with Cl, was related to anthropogenic emissions from the local power plant. The high Cu and Zn enrichments were not as easily traced but may be due to transport of these elements from mine and smelter complexes approxi-mately 200 km to the southwest of Churchill. (Author's abstract)

Sources Of Pollution-Group 58

SEDIMENT NUTRIENT FLUXES IN A TIDAL FRESHWATER EMBAYMENT, Waterways Experiment Station, Vicksburg, MS. For primary bibliographic entry see Field 2L. W88-08030

EXPERIMENTAL VERIFICATION OF MULTI-COMPONENT GROUND WATER CONTAMI-NATION PREDICTIONS,

Malton PREDICTIONS, Michigan Dept. of Natural Resources, Lansing. Waste Management Div. K. M. Clancy, and A. A. Jennings. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 307-316, April 1988. 8 fig. 2 tab, 26 ref. Maryland DNR Contract No. P93-83-04, DOE Contract No. DE-AC02-79EV-10253, and NSF Grant ECE85-04199.

Descriptors: *Soil properties, *Groundwater pollu-tion, *Path of pollutants, Model studies, Solute transport, Prediction, Mathematical studies, Envi-ronmental effects, Hydrology, Aquifers, Soil prop-

Recent advances in mass transport modeling have made possible computation of the theoretical consequences of intricate multicomponent species interactions during ground water contamination events. Predictions such as strong chromatographic effects and induced downstream precipitations may have considerable impact on environmental analysis and regulation. Results of laboratory attempts to verify theoretical multicomponents. ry attempts to verify theoretical multicomponent transport predictions are discussed. Evidence pre-sented here indicates that natural variability of soil sented here indicates that natural variability of soil properties make such verifications difficult. Although species interactions are easily confirmed, dramatic effects often exist only within small mathematical windows in strongly variable coefficient sets. Currently, the ability to generate multicomponent predictions apparently exceeds the ability to quantify the necessary, presumably deterministic, information required for real soils. (Author's abstract) tic, informa abstract) W88-08037

PREDICTING INFILTRATION PARAMETERS FOR A ROAD SEDIMENT MODEL,

Agricultural Research Service, Pullman, WA. G. N. Flerchinger, and F. J. Watts. American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1700-1705, November-December 1987. 2 fig, 4 tab, 17 ref.

Descriptors: *Erosion, *Runoff, *Sediments, *Path of pollutants, *Green-Ampt parameters, *Soil properties, *Model studies, *Infiltration rate, *Inproperties, *Model studies, *Intitration rate, infiltration, Mathematical studies, Prediction, Simulated rainfall, Capillary water, Capillary suction, Water pollution sources, Hydraulic conductivity,

Methods for predicting Green-Ampt infiltration parameters for very coarse-textured soils are not well established. Before accurate runoff and erowell established. Before accurate runn) and ero-sion predictions can be made for these soils, a large data base and correlations to other soil properties are required. Runoff data were collected and infil-tration parameters were determined for simulated trainon parameters were determined for simulated rainfall events on forest roads. These results were combined with data from similar studies, and predictive equations were established for the Green-Ampt infiltration parameters using soil texture and porosity. The equations account for 70% of the variation in hydraulic conductivity and 88% of the variation in capillary suction head. (Author's ab-

EXPORT OF MIREX FROM LAKE ONTARIO TO THE ST. LAWRENCE ESTUARY, National Water Research Inst., Burlington (Ontar-

io). Lakes Research Branch. K. R. Lum, K. L. E. Kaiser, and M. E. Comba

The Science of the Total Environment STENDL, Vol. 67, No. 1, p 41-51, November 1987. 1 fig, 2 tab, 36 ref.

Descriptors: *Lake Ontario, *Eels, *Whales, *Path of pollutants, *Mirex, *Saint Lawrence estuary,

*Path of pollutants, *Solute transport, *Particulate matter, *Fate of pollutants, *Limnology, Water pollution effects, Lake restoration, Organic com-pounds, Heavy metals, Sediments, Water pollution sources, Pesticides.

The relative importance of migrating eels and sus-pended particulate material (biotic and abiotic) as transporters of mirex from Lake Ontario to the St. transporters of mirex from Lake Ontario to the St. Lawrence River Estuary is evaluated in the con-text of a possible adverse impact on the St. Law-rence beluga population. The estimates suggest that transport of mirex out of Lake Ontario by eels (2270 g annually) is almost twice that due to sus-pended particulate flux (1370 g annually). Mass balance calculations for mirex in Lake Ontario indicate that transport by migrating eels and particbalance calculations for mirex in Lake Ontario indicate that transport by migrating eels and particulate matter, combined coverage of surficial sediments by continuing deposition of new material, could effectively 'cleanse' Lake Ontario of mirex inputs in 100 years of less. Using mirex as a prototype to simulate the fate of hydrophobic organic chemicals in Lake Ontario led to a revised sediment budget for this final lake in the Great Lakes. St. Lawrence system. According to this budget, 94% of the suspended particulate material entering Lake Ontario is retained in the depositional basins and, by ierence, most hydrophobic organic contaminants and metal forms having a dominant association with the particulate phase, would be expected to behave in a similar fashion. (Author's abstract)

PALEOLIMNOLOGICAL EVIDENCE OF RECENT ACIDIFICATION IN TWO SUDBURY (CANADA) LAKES,
Trent Univ., Peterborough (Ontario). Trent Aquatic Research Centre.
S. Dixit, A. S. Dixit, and R. D. Evans.
The Science of the Total Environment STENDL, Vol. 67, No. 1, p 53-67, November 1987. 9 fig, 3 tab, 43 ref.

Descriptors: *Diatoms, *Paleolimnology, *Acid rain, *Fate of pollutants, *Smelting, *Lake acidification, *Air pollution effects, *Water pollution effects, *Hydrogen ion concentration, Aquatic habitats, Sulfates, Limnology, Water pollution sources, Ontario, Emissions, Lakes, Sudbury.

As a result of an increase in SO2 emissions from the metal mining and smelting activities in the vicinity of Sudbury, severe detrimental effects have been reported on aquatic ecosystems. However, documentation of the time and rates of lake acidification are not available. The purpose of the present study is to provide this iormation by utilizing the stratigraphic analysis of sedimentary diatoms from Hannah and Clearwater lakes. The study indicates that, in Hannah Lake, acidification occurred soon after the roasting of ore started at Copper Cliff in the 1880s. Between about 1880 and 1975, the ierred lake water pH declined from a high of 6.0 to a low of 4.6. After the lake was neutralized in 1975 its measured pH increased from 4.3 to 7.0. This increase was also indicated by an increase in diatom-ierred pH. In Clearwater Lake, acidification commenced after 1930. Between increase in diatom-ierred pH. In Clearwater Lake, acidification commenced after 1930. Between about 1930 and 1970 the pH declined from 6.0 to 4.2. Due to reduction in SO2 emissions, no further PH decline has occurred since about 1970. The study indicates that, in addition to the existing buffering capacity of the lakes, the lake's distance from the point source and past changes in smelting practices may have greatly influenced the onset of acidification in Sudbury lakes. (Author's abstract) W88.08068

CADMIUM SULFATE APPLICATION TO SLUDGE-AMENDED SOILS: I. EFFECT ON YIELD AND CADMIUM AVAILABILITY TO

Arkansas Univ., Marianna. Eastern Arkansas Soil Testing and Research Lab.
For primary bibliographic entry see Field 5C.
W88-08069

LIMNOLOGICAL STUDIES ON THE NOZHA HYDRODROME, EGYPT, WITH SPECIAL

REFERENCE TO THE PROBLEMS OF POL-

Alexandria Univ. (Egypt). Dept. of Oceanography. M. A. H. Saad.

The Science of the Total Environment STENDL, Vol. 67, No. 2/3, p 195-214, December 1987. 15 fig. 3 tab, 28 ref. International Atomic Energy Agency Research Contracts R1/R2/SD.

Descriptors: "Nozha Hydrodrome, "Tilapia, "Limnology, "Seasonal variation, "Water pollution effects, "Heavy metals, "Path of pollutants, "Bioaccumulation, "Water pollution sources, Lake sediments, Phytoplankton, Tissue analysis, Iron, Egypt, Lakes, Fish, Canals, Nitrites, Phosphates, Diatoms, Silicates, Cadmium.

Water samples were collected in the different seasons during the period 1979-1981 from the Nozha Hydrodrome, Egypt, a small shallow lake receiving polluted Nile water, to gain information on the environmental conditions, nutrient contents, levels of trace metals and their possible variations in relation to pollution effects. The accumulation of trace metals in the lake sediments and in different tissues of the common fish, Tilapia species, was also investigated. The seasonal changes of nutrients in the Hydrodrome are mostly influenced by their allochthonous input, and their main source is the also investigated. The seasonal changes of nutrients in the Hydrodrome are mostly influenced by their allochthonous input, and their main source is the supply of polluted Nile water, which first affects the inlet region. The high concentrations of inorganic nitrogenous and phosphate salts in the feed water are due to the discharge of untreated sewage and industrial wastes, as well as agricultural run-off into the water source of the Hydrodrome (Mahmoudia Canal). The nitrite produced in the lake is principally from nitrification of ammonia. The autochthonous supply of nitrate and phosphate is mainly from the decay of phytoplankton and subsequent release from lake sediments. The increase in silicate coincided principally with dissolution of diatom frustules. The seasonal variations of trace metals in the Hydrodrome are attributed to both external and internal iluences. The external iluences reflect the impact of man on the water source of the Hydrodrome, whereas the internal iluences represents the events which occur within this lake. The data suggest a direct relationship between the concentrations of metals in the lake water and their concentrations in Tilapia fish. The water and their concentrations in Tilapia fish. The data illustrate the ability of fish to absorb high levels of heavy metals and the ability of the lake sediments to accumulate these metals relative to seaments to accumulate these metals relative to those found in the lake water and the fish. In general, iron showed the highest mean values in the lake water, sediments and fish, whereas cadmi-um was present in the lowest concentrations. (Au-thor's abstract) W88-08070

INTERACTIONS BETWEEN POLYCYCLIC AR-OMATIC HYDROCARBONS AND NATURAL AQUATIC HUMIC SUBSTANCES, CONTACT TIME RELATIONSHIP,

Senter for Industriforskning, Oslo (Norway). S. Johnsen.

The Science of the Total Environment STENDL, Vol. 67, No. 2/3, p 269-278, December 1987. 8 fig,

Descriptors: *Path of pollutants, *Hydrocarbons, *Polycyclic aromatic hydrocarbons, *Humic acids, *Water pollution effects, *Adsorption, Analytical methods, Organic compounds, Solubility, Gas chromatography, Mass spectrometry, Solute transport, Bioavailability.

Interactions between polycyclic aromatic hydro-carbons (PAH) and natural aquatic humic sub-stances (NAHS) as a function of contact time were studied. Eight PAH compounds were dissolved in NAHS and recovered by cyclohexane extraction NAHS and recovered by cyclohexane extraction after storage times ranging from 4 to 70 days. Natural water containing low concentrations of humus was used for the blanks. Analyses were carried out by selected ion monitoring gas chromatography/mass spectrometry (SIM GC/MS). In general, the recoveries of all studied PAH, except for triphenylene, decreased with increasing contact time. The results suggest that strong bonds were formed between PAH and NAHS. In the early-

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part of the experiment (4 and 7 days) the recover-ies of the different PAH decreased with increasing octanol-water partition coefficient or decreasing water solubility of the compounds. For the longest water solubility of the compounds. For the longest stored samples (70 days), the recovery of the PAH decreased with increasing compound reactivity. The formation of stable PAH-NAHS complexes will affect the transportation and the bioavailability of PAH. Bonding of organic micropollutants (OMP) to NAHS may result in decreased sedimentation rates, and faster transportation of such pollutants from the source throughout the recipient. On the other hand, the complexation or bonding of OMP to humic substances may reduce the bioavailability of these compounds, and prevent their uptake by living organisms. (Author's abstract) W88-08072

PARTITIONING OF HEAVY METALS INTO SELECTIVE CHEMICAL FRACTIONS IN SEDIMENTS FROM RIVERS IN NORTHERN GREECE, Thessaloniki Univ., Salonika (Greece). Environ-

mental Pollution Control Lab.
V. Samanidou, and K. Fytianos.
The Science of the Total Environment STENDL, Vol. 67, No. 2/3, p 279-285, December 1987. 4 tab,

Descriptors: *Sediments, *Partitioning, *Heavy metals, *Path of pollutants, *Chemical compounds, *Fate of pollutants, Greece, Axios River, Aliakmon River, Lead, Cadmium, Copper, Iron, Manganese, Zinc, Chromium, Sulfides, Carbonates.

A five-step sequential extraction technique was used to determine the chemical association of heavy metals (Pb, Cd, Cu, Fe, Mn, Zn, Cr) with major sedimentary phases (exchangeable cations, easily reducible compounds, organic sulfidic phases, carbonates and residual components) in samples from rivers northern Greece (Axios and samples from rivers northern Greece (rance see Aliakmon). From the obtained data it can be seen that the surplus of metal contaminants introduced into the aquatic system from anthropogenic sources usually exists in relatively unstable chemi-cal forms. A high proportion of the elements stud-ied remains in the residual fraction for the Axios River and in the organic fraction for the Aliakmon. Most of the non-residual portion is bound to ferro-manganese oxides and to organic matter. (Author's abstract) W88-08073

ABUNDANCE AND DISTRIBUTION OF DIS-SOLVED INORGANIC NUTRIENTS IN THE EBRO DELTA BAYS (ABUNDANCIA Y DIS-TRIBUCION DE NUTRIENTES INORGANI-COS DISUELTOS EN LAS BAHIAS DEL DELTA DEL EBRO), Instituto de Ciencias del Mar, Barcelona (Spain).

Instituto de Ciercias dei Mar, Barcelona (Spain). M. Delgado, and J. Camp. Investigacion Pesquera IPESAV, Vol. 51, No. 3, p 427-441, September 1987. 5 fig. 3 tab, 20 ref. CAICYT-CSIC Project AC16/84.

Descriptors: *Salinity, *Cycling nutrients, *Phyto-plankton, *Water pollution sources, *Nutrients, *Path of pollutants, *Estuaries, *Bays, *Inorganic compounds, *Primary productivity, Mineraliza-tion, Biomass, Nitrogen, Phosphorus, Spain, Ebro

Information obtained between 1982 and 1986 on Information obtained between 1962 and 1960 on the abundance and distribution of some inorganic nutrients (nitrite, nitrate, ammonium, phosphate and silicate) in the bays of Fangar and Alfacs, and silicate) in the bays of Fangar and Alfacs, located to the north and south of the Ebro Delta respectively, is described. The highest nutrient concentrations were associated with low salinity waters, coming from fresh water discharged through irrigation channels. In Alfacs the major gradient in nutrient concentrations occurred in the transversal direction of the bay, and the phytoplankton chlorophyll-a distribution was superim-posed on it. Nitrogen and phosphorus (nitrate + nitrite and phosphate forms) entering Alfacs Bay by means of discharged freshwater explain only a small part of the estimated primary productivity (less than 25%). The importance in the bays of organic matter remineralization processes and ap-

parent nitrogen deficiency with respect to phos-phorus are discussed. (See also W88-08088) (Author's abstract)

SEASONAL AND SPATIAL DISTRIBUTION OF PHYTOPLANKTON IN THE RIA OF PON-TEVEDRA (NW SPAIN) (DISTRIBUCION ES TACIONAL Y ESPACIAL DEL FITOPLANC-TON EN LA RIA DE PONTEVEDRA (NO DE ESPANAL)

ESPANA)), Instituto de Investigaciones Marinas, Vigo (Spain). For primary bibliographic entry see Field 2L. W88-08092

RELATIONSHIPS BETWEEN BATHYMETRY, WATER QUALITY AND DIATOMS IN SOME

HEBRIDEAN LOCHS,
University Coll., London (England). Palaeoecology Research Unit. For primary bibliographic entry see Field 2H. W88-08096

SPATIAL DISTRIBUTION OF DENITRIFYING ACTIVITY IN A STREAM DRAINING AN AGRICULTURAL CATCHMENT,

Oxford Univ. (England). Dept. of Plant Sciences. J. G. Cooke, and R. E. White. Freshwater Biology FWBLAB, Vol. 18, No. 3, p 509-519, December 1987. 4 fig, 4 tab, 20 ref.

Descriptors: *Nonpoint pollution sources, *Fate of pollutants, *Agricultural runoff, *Denitrification, *Nitrogen removal, *Enzymes, *Streams, Sediments, Spatial distribution, Distribution patterns, Cores, River Dorn, England, Silt, Sand, Gravel, Nitrate, Water quality.

A field study was made of the spatial distribution of denitrification activity in the sediment of the River Dorn, Oxfordshire, England. An assay of River Dorn, Oxfordshire, England. An assay of denitrifying enzyme activity was used to examine the distribution of denitrification with depth in cores of sediment representative of the types found in the stream. The maximum activity recorded in a predominantly silt sediment core was 5 times greater than that recorded in a sandy gravel core. In both fine sand and silt cores, peaks in denitrifier enzyme activity were shown to correspond to the limit of the nitrate diffusion front. At this depth the redox potential dropped rapidly from +300 mV to limit of the nitrate diffusion front. At this depth the redox potential dropped rapidly from +300 mV to 0 or less. Denitrifying enzyme activity in the stream water was negligible. In situ denitrification activity (IDA) measurements were carried out in an 800 m reach of the Dorn using the acetylene inhibition technique, or small cellipart cover. Coninhibition technique on small sediment cores. Con-current measurements were also made of stream depth and velocity, nitrate concentration in the interstitial water, and the wet bulk density, loss on ignition, mineralizable carbon and total nitrogen contents of the sediment. Mineralizable carbon was contents of the sediment. Mineralizable carbon was the variable which showed the best correlation with IDA. Highest IDAs were associated with accumulations of fine-grained sediment at meander bends. Mean IDAs measured under flood conditions were significantly higher (P<0.05) than those measured under baseflow. It was estimated that denitrification reduced the nitrate load in the River Dors but 15% under numer these flow conditions. Dorn by 15% under summer baseflow conditions (Author's abstract)
W88-08112

DISTRIBUTION COEFFICIENTS OF CD, CO, NI, AND ZN IN SOILS,
Technical Univ. of Denmark, Lyngby. Dept. of

Sanitary Engineering.
P. R. Anderson, and T. H. Christensen.
Journal of Soil Science JSSCAH, Vol. 39, No. 1, p

15-22, March 1988. 1 fig, 5 tab, 19 ref.

Descriptors: *Soil contamination, *Soil chemistry, *Heavy metals, *Cadmium, *Solute transport, *Cobalt, *Nickel, *Zinc, Adsorption, Clays, Iron, Manganese, Oxides, Hydrogen ion concentration, Correlation analysis, Statistics, Path of pollutants.

Batch adsorption experiments were conducted with a mixture of solutes at low equilibrium concentrations of cadmium (0.7-12.6 micrograms/

liter), cobalt (18-118 micrograms/liter), nickel (22-330 micrograms/liter), and zinc (40-1480 micro-grams/liter) in 38 different soils. Statistical correlagrams niet) in 36 different sols. Statistical corrections indicated that metal sorption onto the soils was influenced by the presence of clays and hydrous oxides of iron and manganese. Based on calculated distribution coefficients for these metals, calculated distribution coefficients for these metals, cobalt will generally exhibit the highest mobility in soils, but the mobility of zinc will increase faster with decreasing pH. Two types of empirical relationships are developed from these data to estimate values for the distribution coefficients. (Author's abstract) W88-08134

BIODEGRADATION OF SUBSTANCES AT LOW CONCENTRATIONS (BIOLOGISCHER ABBAU VON STOFFEN BEI GERINGEN KON-ZENTRATIONEN),

BASF A.G., Ludwigshafen am Rhein (Germany,

Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 101-107, August 1987. 1 tab, 72 ref.

Descriptors: *Aquatic ecosystems, *Water pollu-tion sources, *Water pollution effects, *Biodegra-dation, Ecological effects, Effluents, Toxins, Eco-systems, Surface water.

The testing of a substance's biodegradability is crucial to an assessment of its ecological compatibility. A short-lived cootoxin represents less of a risk than a long-lived one. Modern analytical techniques often show that surface waters and effluent from water-treatment plants contain not only long-lived substances but also those that were classified as being biodegradable. In addition to hydraulic reasons for this, there may be microbiological causes, which are discussed with reference to literature sources. Examples of substances that are found in surface waters are also provided. The paper concludes with a discussion on the attendant paper concludes with a discussion on the attendant ecotoxicological risks of a substance that is present at low concentrations in surface water. (Author's W88-08150

REMOBILIZATION OF HEAVY METALS REMOBILIZATION OF HEAVY METALS FROM RIVER DEPOSITS BY ORGANIC COMPLEXING AGENTS: 2. NOTE-REMOBILIZATION OF CU, PB, CD, NI, ZN, AND MN BY OVERACIDIFICATION OF WATERS AND BY NTA (ZUR REMOBILISIERUNG VON SCHWERMETALLEN AUS FLUSS-SEDIMENTEN DURCH ORGANISCHE KOMPLEX-BILDNER: 2. MITT: REMOBILISIERUNG VON CU, PB, CD, NI, ZN UND MN DURCH VERSAUERUNG DES GEWASSERS UND DURCH NTA). **DURCH NTA),**

Gould Defense Systems, Inc., Glen Burnie, MD. Defense Electronics Div.

F. Dehnad, K. Wisser, and M. Rieck.

Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 114-117, August 1987. 1 fig, 5 tab, 8 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Copper, *Lead, *Path of pollutants, *Sediments, *Cadmium, *Nickel, *Zinc, *Manganese, *River beds, *Nitrilotriacetic acid, Acidity,

Remobilization of Elbe River deposits by NTA content of the river water and as a function of acidity has been investigated. Local overacidification (e.g., acid waste flowing in surface waters) remobilizes deposited heavy metals, which mainain increased concentrations after mixing and neutralization. Also, any content of NTA in surface waters remobilizes deposited metals according to their concentrations in solution and to their contents of chestion. A screen of tests indicated that a stants of chelation. A series of tests indicated that a content of 200 micrograms/liter NTA effected at least 95% chelation by metals-83% by remobiliza-tion of zinc, nickel, and copper, and 12% by remo-bilization of calcium. (Author's abstract)

Sources Of Pollution—Group 5B

EMISSION AND IMMISSION OF ORGANIC HALOGEN COMPOUNDS IN THE CATCHMENT AREA OF THE RIVER RUHR,

NENT AREA OF THE RIVER ROTH, Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab. R. Klopp, and K.H. Kornatzki. Zeitschrift füer Wasser - und Abwasser Forschung ZWABAQ, Vol. 20, No. 5, p 160-167, October 1987. 10 fig, 25 ref.

Descriptors: *Organic halogen compounds, *Ruhr, *Water pollution sources, *Organic compounds, *Halogens, *Catchment areas, Rivers, Wastewater treatment plants, Runoff, Spruce trees, Terpenes, Sunlight exposure, Organic halogen compounds, Ruhr river, Rainfall, Municipal wastewater.

By measuring the immission and emission of AOX (organic halogen compounds), the origin and location of halog-containing substances were investigated in the catchment area of the River Ruhr.

The of the annual AOX-emission into the receivement of the control of fifth of the annual AOX-emission into the receiving waters arises from municipal clarification plants, a third from direct emitting cellulose works and nearly half from diffuse sources caused by precipitation. The average AOX-concentration in falling rain is about 20 micrograms/1, which increases in the run-off from unpaved areas and in groundwater run-off which is close to the surface. The AOX-load in run-off from paved areas is nearly as high as in municipal waste waters. Laboratory experiments showed the formation of halogen-containing organic substances when HCl-gas reacts with unsaturated terpenes from natural spruce oil under exposure to sunlight. These findings raise the question of whether or not a considerable part of the AOX in receiving waters is of biogenic origin. (Author's abstract) biogenic origin. (Author's abstract) W88-08159

TOTAL BACTERIAL CELL COUNTS AND ESTERASE-ACTIVITY IN A SMALL UNPOLLUTED STREAM DURING THE MAIN VEGETA-

TIVE PERIOD,
Gesamthochschule Essen (Germany, F.R.). Fachbereich 9 - Geologie.

E. Schuller. Zwaba, Vol. 20, No. 6, p 189-192, December 1987. 4 fig, 22 ref.

Descriptors: *Bacteria, *Self-purification, *Sediments, *Water analysis, *Bacterial analysis, *Engymes, *Chemical analysis, *Stream biota, Vegetative period, Esterase activity, Cell counts, Ruhr

From May to October 1986, 40 water samples and 32 sediment samples were collected from a small unpolluted woodland stream (tributary of the Ruhr, near Essen). Total bacterial biomass was Runr, near Essen). Total bacterial biomass was measured by epifluoresence microscopic counts (EMC). The heterotrophic activity was recorded by analysis of esterase activity with fluoroscein diacetate (FDA). In the moving body of water, the concentration of total bacteria distinctly increased with distance from the source, mainly due to the with distance from the source, mainly due to the input of terrestrial bacteria. However, the esterase activity showed only slight differences between source and lower reaches of the stream. In the sediment, there was a significant linear correlation between total bacterial counts and enzymatic activity. (Author's abstract) W88-08163

APPLICATION OF DIALYSIS BAGS FOR MONITORING THE GROUNDWATER QUALITY DOWNSTREAM OF A LANDFILL, Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer

Hydrologie.
For primary bibliographic entry see Field 5A.
W88-08165

DISTRIBUTION OF ORGANIC MICROPOL-LUTANTS IN DIFFERENT SIZE FRACTIONS OF SEDIMENT AND SUSPENDED SOLID PARTICLES OF THE RIVER ROTMAIN,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie. G. Umlauf, and R. Bierl.

Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 20, No. 6, p 203-209, December 1987. 15 fig, 2 tab, 26 ref.

Descriptors: *Chlorinated hydrocarbons, *Pollut-ant identification, *Sediments, *Suspended sedi-ments, *Chemical analysis, *Hydrocarbons, Rot-main River, Polycyclic aromatic hydrocarbons, River, Organic compounds, Polychlorinated bi-phenyls, Water pollution sources.

The partitioning of several organic micropollutants (gamma-HCH (hexachlorocyclohexane), PCB (polychlorobiphenyl), PAH (polycyclic aromatic hydrocurbons)) to sediments and suspended solids of a lightly polluted river in northeast Bavaria was investigated. An elutriator system was used to a lightly polluted river in nortness davarus was investigated. An elutriator system was used to obtain different particle size fractions. In situ fractionation and analysis of suspended sediment revealed that about 60% of the total load of polycyclic aromatic hydrocarbons is transported by vealed that about 60% of the total load of polycy-clic aromatic hydrocarbons is transported by middle silt fractions. Trace organics with lower partition coefficients like gamma-HCH were mainly found in solution. The maximum adsorption of PAH in the middle and coarse silt fractions could be related to the content of organic carbon and the extent of degradation of the humic materi-al. (Author's abstract) W88-08166

BIOLOGICAL DEGRADATION OF VOLATILE BIOLOGICAL DEGRADATION OF VOLATILE CHLORINATED HYDROCARBONS IN GROUNDWATER AND SEWAGE, Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene. M. Nerger, and R. Mergler-Volkl. Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 21, No. 1, p 16-19, February 1092

Descriptors: *Fate of pollutants, *Path of pollutants, *Chlorinated hydrocarbons, *Biodegradation, *Microbial degradation, *Groundwater pollution, *Carcinogens, *Drinking water, Human diseases,

In the groundwater of an area contaminated by tetrachloroethene a sequential dechlorination of tetrachloroethene via trichloroethene and cis-1,2-dichlorothene to vinyl chloride under anaerobic dichlorothene to vinyl chloride under anaerobic conditions was observed for a flow distance of about 500 m. The concentrations of cis-1,2-dichloroethene and vinyl chloride detected in groundwater were 1600 microns/l and 120 microns/l although neither of the 2 substances were identified as primary contaminants in the investigation area. The possibility of microbiological degradation of tetrachloroethene under different conditions was investigated by laboratory tests. The results give rise to the assumption that degradation of chlorinated hydrocarbons underground is mainly a microbiological process. For reasons of drinking water hygiene, particular attention should be paid to these transformation processes and their environment requirements since one of the metabolites, vinyl chloride, is known as a human carcinogen. (Author's abstract) (Author's abstract) W88-08172

BENZENE IN THE ANOXIC HYPOLIMNION OF A FRESHWATER LAKE, Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie. F. Juttner.

Naturwissenschaften NATWAY, Vol. 75, No. 3, p 151-153, March 1988. 2 fig, 9 ref.

Descriptors: *Lakes, *Benzenes, *Hypolimnion, *Water pollution sources, *Microorganisms, Anoxia, Toluene, Biogenic formation, Path of pol-

During a study of a small lake with anoxic hypo-During a study of a small lake with anoxic hypolimnion, accumulation of benzene was observed which could not be assigned to anthropogenic sources but points to a microbial origin. The lake studied (Schleinsee, SW Germany) has an area of 0.15 sq km, a maximum depth of 10.5 m, and a residence time of water of 2.1 yr. An anoxic hypolimnion develops every year. Lake Schleinsee was studied over a period of 3 years. After turnover in

the late autumn and early spring, an anoxic hypothe late autumn and earry spring, an anoxic hypo-limnion was observed every year in the summer and autumn. While different aromatic compounds introduced into the water body by pollution or runoff from the lithosphere (C2- and C3-benzenes) exhibited fairly closely related concentrations in exhibited fairly closely related concentrations in both the oxygen-containing and oxygen-depleted water layers, the concentrations of benzene and toluene increased significantly towards the sediment. After the turnover of the lake water, a homogeneous distribution of both compounds was observed in the lake. As soon as anoxic hypoliminon developed after stratification of the lake, the benzene and toluene concentrations again increased in the hypoliminon. Intense degradation of organic matter and protein as indicated by the high concentrations of ammonium ions was taking place. Reports on a biogenic formation of benzene from carbon compounds such as phenylalanine are lacking and may be overlooked. The data of Lake Schleinsee, however, indicate that such processes may occur in anoxie environments. (Brock-PTT) may occur in anoxic environments. (Brock-PTT) W88-08174

BOUNDARY ELEMENT APPROACH FOR MODELLING GROUNDWATER MOVEMENT, Thessaloniki Univ., Salonika (Greece). School of Technology. For primary bibliographic entry see Field 4B. W88-08185

DERIVATION OF BASIC EQUATIONS OF MASS TRANSPORT IN POROUS MEDIA: PART 1. MACROSCOPIC BALANCE LAWS,

Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Leidschendam (Netherlands). S.M. Hassanizadeh.

Advances in Water Resources AWREDI, Vol. 9, No. 4, p 196-206, December 1986. 3 tab, 27 ref,

Descriptors: *Thermodynamics, *Porous media, *Fluid flow, *Mathematical models, *Hydrologic models, *Earth-water interfaces, *Path of pollutants, Macroscopic balance laws, Darcy's Law, Fick's Law, Brines.

In the first of 2 papers on the development of a general thermodynamic basis for the study of transport phenomena in a porous medium composed of a multi-component fluid flowing through a porous rock skeleton, macroscopic balance laws for mass, momentum, energy and entropy of solid phase and individual species of the fluid phase were derived starting from a microscopic description of the porous medium. Fluid components are miscible and homogeneous thermodynamic interactions among them take place at the molecular miscrole and nongeneous thermodynamic interactions among them take place at the molecular level. Heterogeneous thermodynamic interactions occur between fluid components and the rock at solid-fluid interfaces. In the microscopic description of the medium, balance laws of continuum theories of mixtures are employed as the governing countrions at coints within the fluid observed. theories of mixtures are employed as the governing equations at points within the fluid phase. At points within the rock aggregates, classical balance equations of continuum mechanics are employed. Interfacial jump conditions are given to account for interactions between fluid species and the rock. By averaging these 3 sets of equations, one arrives at macroscopic equations of balance. A macroscopic formulation of the second law of thermodynamics for the medium is also provided Macronamics for the med namics for the medium is also provided. Macro-scopic balance laws will have to be supplemented by appropriate constitutive relations to obtain a complete thermodynamic theory of transport processes in porous media. This approach, both in concept and methodology, is the same as that developed by Hassanizadeh and Gray. It makes it possible to take into account coupling of thermo-dynamic effects. Among the final results, a generalization of Fick's and Darcy's Laws for transport of concentrated brine in porous media was provided. (Author's abstract)

DERIVATION OF BASIC EQUATIONS OF MASS TRANSPORT IN POROUS MEDIA: PART 2. GENERALIZED DARCY'S AND

Group 5B—Sources Of Pollution

Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Leidschendam (Netherlands). S.M. Hassanizadeh.

Advances in Water Resources AWREDI, Vol. 9, No. 4, p 207-222, December 1986. 18 ref, 2 append.

Descriptors: *Mathematical models, *Hydrologic models, *Path of pollutants, *Porous media, *Entropy, *Brines, Fick's Law, Darcy's Law, Coleman and Noll method, Mass transport:

In the second of a series of 2 papers on the development of a general thermodynamic basis for the study of transport phenomena in porous medium is modeled as a superposition of one solid continuum interacting with an N-component fluid-phase continuum. Macroscopic balance laws derived in Part 1 provide the equations of mass and momentum for the mean motion of the fluid phase and diffusive motions of individual components. The Coleman and Noll's method of components. The Coteman and Notis' metrod of exploitation of the entropy inequality was applied to restrict a rather general set of constitutive equations. Gradients of the fluid-phase density and concentrations of N-1 components are included among independent variables to account for buoyancy and cross-coupling effects properly. Extensions of certain classical relations for fluid-phase pressure, solid stress tensor, and components' chemical po-tentials were obtained as results of the constitutive tentials were observed as the state of the constitutive theory. Further simplifications and linearizations of constitutive equations and balance laws yield a general extension of Darcy's and Fick's Laws, applicable to cases where the fluid has more than applicable to cases where the fluid has more than one main component. Both relations have to be modified to account for the effect of high concentrations. Classical forms of those laws are valid only if fluid components exist at low concentrations. All assumptions were carefully and explicitly stated during the course of development. As an illustration of the theory, proper forms of Darcy's and Fick's Laws for the flow and transport of concentrated brine in porous media are given. The development also provides a fundamental basis for equations used in the description of chemico-osmosis effects. (See also W88-08188) (Author's abstract) stract) W88-08189

QUALITATIVE UV SPECTROSCOPIC METHOD AS AN INITIAL GUIDE TO SOURCE ORIGINS OF POLYCYCLIC ARO-MATIC HYDROCARBONS,

National Univ. of Singapore. Dept. of Chemistry. H. K. Lee, G. J. Wright, and W. H. Swallow. Environmental Pollution EPEBD7, Vol. 49, No. 3, p 167-175, 1988. 7 fig, 20 ref.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Spectroscopy, *Chemical analysis, *Pollutant identification, *Water pollution sources, Chromatography, Water analysis, Reagents, Sample preparation, Laboratory equipment.

A qualitative method for determining the source origins of polycyclic aromatic hydrocarbons (PAH) in the environment is described. The method, using ultraviolet spectroscopy, takes ad-vantage of the fact that aromatic compounds exhibit strong absorption in the ultraviolet region. It offers a fast and convenient alternative to other offers a fast and convenient alternative to other methods, which usually require extensive cleanup to avoid or limit interference during analysis; this method requires only basic column chromatography to isolate the target compounds. A Soxhlet apparatus was used for initial extraction, with each extraction requiring several hours. Use of an ultrasonic extractor should enhance the time-saving qualities of the technique. Examples of the application of the method are discussed, and the results are corroborated by those previously obtained by are corroborated by those previously obtained by other methods. It is concluded that, while the UV orner methods. It is concluded that, while the UV method is not as discriminating as statistical analysis in determining PAH origins, it has the advantage of speed and can be supplemented by a more exacting method if necessary. Representative UV profiles of river sediment are similar to those of domestic emission extracts indicating that domestic chimney emissions are in river sediments. (Author's abstract) W88-08197

STUDIES ON METAL CONTENT IN THE BROWN SEAWEED, FUCUS VESICULOSUS, FROM THE ARCHIPELAGO OF STOCK-

Uppsala Univ. (Sweden). Dept. of Physiological

Bodany.

A. Forsberg, S. Soderlund, A. Frank, L. R. Petersson, and M. Pedersen.
Environmental Pollution EPEBD7, Vol. 49, No. 4, p 245-263, 1988. 3 fig. 9 tab, 35 ref.

Descriptors: *Tissue analysis, *Plant physiology, *Fucus, *Stockholm, *Heavy metals, *Bioindica-tors, *Water pollution sources, Phaeophyta, Alu-minum, Cadmium, Cobalt, Chromium, Copper, Iron, Manganese, Nickel, Lead, Vanadium, Zinc, Pollutant identification, Indicators, Water pollu-

Concentrations of 11 metals (Al, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, V, and Zn) were determined in the brown seaweed Fucus vesiculosus collected from the Archipelago of Stockholm. Several factors that the Archipelago of Stockholm. Several factors that influence the metal content in the seawed have been studied, including errors caused by epiphytes, sea exposure, and differences based on which part of the plant is analyzed. It is concluded that, if all these factors are considered, Fucus vesiculosus plants are excellent bioindicators of metal pollution. This is also demonstrated by a significant increase in metal content in transplanted Fucus vesiculosus near the city of Stockholm. The results from this investigation also indicate increasing metal concentrations, especially Cd, in samples from the northern parts of the Archipelago; this increase could result from industrial activities or runoff from mineralized rivers. It could also indicate increased biological availability at northern cate increased biological availability at northern localities. (Doria-PTT) W88-08199

RELATIONSHIP BETWEEN HYDROGEN AND SULPHATE IONS IN PRECIPITATION: A NU-MERICAL ANALYSIS OF RAIN AND SNOW-FALL CHEMISTRY,

A.S.L. and Associates, Helena, MT. A. S. Lefohn, and S. V. Krupa. Environmental Pollution EPEBD7, Vol. 49, No. 4, p 289-311, 1988. 5 fig, 5 tab, 21 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Ions, *Acid rain, *Sulfates, *Chemistry of precipitation, *Numerical analysis, *Rain, *Snow, Cations, Anions, Precipitation, Rainfall, Air pollution, Air pollution effects, Indicators, Sulfur dioxide, Chemistry.

Selected data on rain and snowfall chemistry were reviewed and numerical analyses conducted to assess the relationship between hydrogen and sulfate ion concentrations. The strength of the association between these ions was varied from site to site. In the Midwestern and Eastern regions, the Pearson correlation coefficient was > 0.50, while in the Central and Upper Midwestern United States, the correlation coefficients were < 0.25. Regardless of the strength of the association, all but one of the National Atmospheric Deposition Program sites assessed exhibited at least 30% of the anions (sulfate, nitrate, and chloride) associated with cations other than hydrogen. For sites where the anions (sulfate, nitrate, and chloride) associated with cations other than hydrogen. For sites where the strength of the association was weak, between 65% and 98% of the anions appeared to be associated with cations other than hydrogen. Because a large percentage of the anions appear to be associated with cations other than hydrogen even at those sites where the association between hydrogen and sulfate ions was strong, it is concluded that the complex chemistry controlling the acidity in precipitation may make it difficult to predict the impact of a reduction in sulfate concentration. (Doria-PTT)

SWELL MODEL OF THE GERMAN BIGHT, Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).

For primary bibliographic entry see Field 2L.

BEHAVIOUR AND TRANSPORT OF OIL UNDER SMOOTH ICE,
Waterloo Univ. (Ontario). Dept. of Civil Engineer-

ing.
J. Puskas, E. McBean, and N. Kouwen.
Canadian Journal of Civil Engineering CJCEB8,
Vol. 14, No. 4, p 510-518, August, 1987. 10 fig, 4

Descriptors: *Oil, *Oil slicks, *Path of pollutants, *Ice, *Model studies, *Boundary layers, *Ice-water interfaces, Mathematical models, Interfaces, Water currents, Flow characteristics, Shear, Oil pollution, Friction, Drag, Hydraulics, Viscosity, Physical properties, Rheology, Engineering, Environmental engineering, Oil spills, Ice cover.

A mathematical model was developed to describe the transport of crude oil slicks under smooth ice. The expressions for the relevant forces were developed from basic boundary layer theory and tested through a set of physical experiments using three different oils in the laboratory. The oil with low viscosity always formed a long, narrow slick oriented in the direction of water flow, whereas the oils with higher viscosities usually formed short, wide slicks oriented transversely to the water flow direction. It was found that the transport of oil slicks oriented longitudinally to the water flow can be modeled by balancing the shear force at the oil-water interface and the oil-ice friction force. An additional form drag force is the dominant driving force for oil slicks oriented transversely to the flow. For oil slicks with low viscosities, the oil-ice force for oil slicks oriented transversely to the flow. For oil slicks with low viscosities, the oil-ice friction force can be approximated by assuming no-slip' at the oil-ice interface. Although these experiments were limited to water velocities in the range of 10-20 cm/s under smooth ice, the results can be used as the basis for further research using ice of varying roughness and different flow regimes. (Doria-PTT)
W88-08209

VERIFICATION OF A NUMERICAL BEACH WATER QUALITY MODEL,
Gore and Storrie Ltd., Toronto (Ontario).

For primary bibliographic entry see Field 5A. W88-08212

SALINIZATION OF RIVERS AND STREAMS: AN IMPORTANT ENVIRONMENTAL

AN IMPORTANT ENVIRONMENTAL HAZARD,
Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams.
AMBIO AMBOCX, Vol. 16, No. 4, p 180-185, 1987. 6 fig, 6 tab, 18 ref.

Descriptors: *Salinization, *Salinity, *Rivers, *Streams, *Water management, Economic aspects, Ecological effects, Semiarid lands, Australia, Africa, North America, Education.

Increases in the salinity of rivers and streams in many dry parts of the world pose an ecological hazard. The significance of this hazard has been largely overlooked in the concern to investigate more obvious economic effects and how to mitigate them. This article discusses the nature and rate of salinity change, where it is occurring, the causes for increased salinity and what can be done to mitigate the phenomenon. Examples of salinization problems in Australia, Africa, and North America are discussed. Salinization is an important problem in all dry parts of the world where dryland farming is practiced, but it is not limited to arid and semiarid areas. The first objective in managing aquatic salinization must be to provide water managers with a better understanding of the ecological effects of salinization of rivers and streams. (Sand-PTT) (Sand-PTT)

CADMIUM ACCUMULATION AND DEPURA-TION IN ANODONTA ANATINA EXPOSED TO CADMIUM CHLORIDE OR CADMIUM-EDTA COMPLEX,

Utrecht Rijksuniversiteit (Netherlands). Dept. of Experimental Zoology.
D. A. Holwerda, J. Hemelraad, P. R. Veenhof, and

Sources Of Pollution—Group 5B

D. I. Zandee. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 3, p 373-380, March 1988. 4 fig, 1 tab, 17 ref.

Descriptors: *Accumulation, *Tissue analysis, *Path of pollutants, *Ecxeretion, *Clams, *Metal complexes, *Cadmium, *Depuration, *Biocaccumulation, *Bioconcentration, *Chelation, *Heavy metals, *EDTA, Path of pollutants, Toxicity, Aquatic invertebrates, Freshwater clam, Cadmium accumulation, Cadmium-EDTA complex, The Netherlands.

In previous studies, Cadmium excretion was invariably found to be less than uptake and it has been suggested that Cd release from organs occurs at different rates and that the metal is also redistributed in the depuration phase. The purpose of this investigation is to study the effect of chelation on cadmium kinetics, including metal elimination in the post-exposure phase. Specimens of the freshwater clam Anodonta anatina L. were collected from a pond near Leiden (South Holland), exposed to Cadmium chloride or CD-EDTA complex, and then dissected. Time dependent change of total soft body weight and gill dry weight as well as the time courses of Cd accumulation and elimination for total soft parts and for gills, mantle edge, kidney and midgut were plotted. (Miller-PTT)

ELIMINATION KINETICS OF TWO UNMETA-BOLIZED POLYCHLORINATED BIPHENYLS IN POECILLA RETICULATA AFTER DIE-TARY EXPOSURE,

Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
S. M. Schrap, and A. Opperhuizen.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 3, p 381-388, March 1988. 3 fig. 25 ref.

Descriptors: *Excretion, *Bioconcentration, *Biological magnification, *Animal metabolism, *Fish diets, *Fish, *Polychlorinated biphenyls, *PCBs, *Bioaccumulation, *Path of pollutants, *Guppies, *Blimination kinetics, Kinetics, Dietary exposure, Hydrophobic chemicals, The Netherlands.

Persistent hydrophobic chemicals which are present in the environment can accumulate to high concentrations in living organisms. Steady state bioconcentration factors (ratios between concentrations in organism and water) or biomagnification factors (ratios between the organism and food) measured with fish in laboratories are often used to estimate the importance of this undesirable process. In addition, to provide simplified estimates of bioconcentration or biomagnification factors, correlations between octan-l-ol/water partition coefficients and solubility in water have been evaluated. In this paper, elimination rates of 2.2°.3.3°.5° hexand 2.2°.3.3°.44°.5.5° octachlorobiphenyl after dietary exposure are investigated. The data of the elimination process are described by first order kinetics. It is shown that after any exposure period, residual concentrations of polychlorinated biphenyls will probably never be found in guppies even after continued dietary exposure. (Miller-PTT) W88-08246

EFFECTS OF TECHNICAL AND COMMERCIAL GRADE PHOSPHAMIDON ON THE CARBOHYDRATE METABOLISM IN SELECTED TISSUES OF PENAEUD PRAWN, METAPENAEUS MONOCEROS (FABRICIUS), Sri Venkateswara Univ., Tirupati (India). Dept. of Marien Technical Comments of the Comments of Marine Zoology.

For primary bibliographic entry see Field 5C.

W88-08247

DISAPPEARANCE RATES OF CHLOROTHA-LONIL (TCIN) IN THE AQUATIC ENVIRON-

MENT, Tasmanian Inland Fisheries Commission, Hobart

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 3, p 405-409, March 1988. 4 tab, 11 ref.

Descriptors: *Fate of pollutants, *Chlorothalonii, *Bioaccumulation, *Path of pollutants, *Fungicides, *Hydrolysis, *Biodegradation, *Aquatic environment, TCIN, Aquatic pollution, Pesticides, Disappearance, Australia, Toxicity, Pesticide toxicity.

Chlorothalonil (TCIN) is a chlorinated isophthalonitrile fungicide with low water solubility. It is highly toxic to fish (Davies and White 1985) with 96 h LC50 values in the range 10-30 microgram per liter, and is rapidly metabolized to glutathione conjugates. It is released into streams at low total concentrations after agricultural spraying operation. TCIN is biodegraded in temperate soils to its 4-hydroxy phenolic derivative, DAC3701, with a half-life of 2.5-3 months. DAC3701 is also produced by aqueous hydrolysis of TCIN. A series of experiments was performed using TCIN and Carbon14-TCIN in aqueous solutions from different sources, at different temperatures and with different stream substrates, to evaluate the nature and rates of TCIN was highly associated with suspended material (as non-filterable residue) in stream water. Loss of TCIN in the aquatic environment. TCIN was highly associated with suspended material (as non-filterable residue) in stream water. Loss of TCIN in 101 h when the water was aerated, indicating enhanced loss by volatilization and/or surface adsorption. The addition of rock with attached algal aufwuchs caused a still greater enhancement of TCIN loss so that only 10% reamined at 2 days, with none detected at 10 days. Loss of TCIN at 5 C was markedly slower than at 15 C. The algal aufwuchs layer on stream cobbles played a dominant role in TCIN removal from the water column. Removal of aufwuchs from cobbles caused a decrease by a factor of 61 in TCIN loss rates. The rate of TCIN loss was not significantly enhanced by the presence of a sterile dolerite rock surface in aquaria. (Miller-PTT)

DIURNAL PATTERNS OF AMMONIUM AND UN-IONIZED AMMONIA IN STREAMS RE-CEIVING SECONDARY TREATMENT EFFLU-ENT.

ENT, Iowa State Univ., Ames. Dept. of Botany. W. G. Crumpton, and T. M. Isenhart. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, 4, p 539-544, April 1988. 3 fig. 12 ref. U.S. Department of the Interior and Iowa State Water Resources Research Insti-tute Project No. G-1017-05.

Descriptors: *Path of pollutants, *Ammonia, *Water pollution effects, *Ammonium, *Stream pollution, *Effluents, *Secondary wastewater, *Dirarla patterns, *Wastewater effluents, Wastewater, Streams, Fate of pollutants, Un-ionized ammonia, *Chemical Substitute 11 offsets | Chemical Substitute 11 of Chemical pollution, pH effects, Temperature effects, USA.

The effects of fluctuating concentrations of ammonia could easily be especially significant in streams receiving sewage treatment effluent. Ammonia receiving sewage treatment effluent. Ammonia loads from sewage treatment plants often display pronounced diurnal patterns which may be imparted to receiving streams. In addition, diurnal patterns in stream pH and temperature could significantly affect ammonia speciation. The pH of most surface waters is controlled by equilibria between CO2, HCO3(-), and CO3(-2). Photosynthetic consumption of CO2 tends to increase pH during the day while respiratory production of CO2 tends to decrease pH at night. Diurnal patterns in pH due to photosynthesis and respiration could significantly affect ammonia speciation and thus un-ionized ammonia concentration in poorly buffered or highly productive streams. This paper describes diurnal patterns in ammonium and un-ionized ammonia in a stream receiving secondary treatment monia in a stream receiving secondary treatment effluent and illustrates the effects of effluent loads, pH and temperature on un-ionized ammonia pat-terns. (Author's abstract) W88-08256

SNOWPACK ION ACCUMULATION AND LOSS IN A BASIN DRAINING TO LAKE SUPE-RIOR.

Michigan Technological Univ., Houghton. Dept. of Biological Sciences.

For primary bibliographic entry see Field 2K. W88-08265

AMMONIUM TRANSFORMATIONS IN SPRINGWATER WITHIN THE RIPARIAN ZONE OF A SMALL WOODLAND STREAM, York Univ., Toronto (Ontario). Dept. of Geogra-

A. R. Hill, and J. Warwick. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 11, p 1948-1956, November 1987. 4 fig, 3 tab, 24 ref.

Descriptors: *Biotransformation, *Path of pollut-ants, *Streams, *Substrates, *Ammonium, *Spring water, *Riparian zone, *Stream chemistry, *Nitro-gen cycle, Ammonium transformation, Nitrates, Nutrient inputs, Woodland streams, Canada.

Nutrient inputs, Woodland streams, Canada.

Field enrichments with ammonium were conducted for periods of 4-4.5 hours on two springs in the riparian zone of a small woodland stream near Toronto, Ontario. Springwater lost much of the injected ammonium as it flowed over organic and sandy riparian substrates before entering the stream. Negligible nitrate release occurred during the ammonium enrichments. Laboratory experiments revealed that riparian substrates rapidly removed ammonium from enriched springwater. Sediments covered with aerated ammonium-enriched water showed a small nitrate-N increase of 9-12 micrograms per L after 5 hours. An absence of ammonium depletion in sterilized organic substrates and very small losses in low-temperature (1 degree Centigrade) incubations suggested that microbial activity rather than adsorption was responsible for ammonium trom springwater overlying acetylene-treated substrates despite the complete inhibition of nitrification, indicated that microbial immobolization was mainly responsible for ammonium depletion. We suggest that ammonium transformations in spring-fed areas of overland flow within the riparian zone may contribute significantly to the regulation of nitrogen inputs to small woodland streams. (Author's abstract)

W88-08267

PHOPSHATE ION INTERACTIONS AT THE SEDIMENT-WATER INTERFACE IN LAKE ONTARIO: RELATIONSHIP TO SEDIMENT ADSORPTION CAPACITIES,

National Water Research Inst., Burlington (Ontar-

P. G. Manning. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2204-2211, December 1987. 3 fig, 7 tab, 25 ref.

Descriptors: *Limnology, *Iron, *Fate of pollut-ants, *Lake Ontario, *Lakes, *Lake chemistry, *Phosphates, *Mossbauer spectroscopy, *Nuclear gamma resonance spectroscopy, Sedimentation, Phosphorus, Manganese, Algae biomass, Sediment-water interfaces, Spectroscopy.

The chemical forms of iron and phosphorus in surficial sediments of the Niagra Basin of Lake Ontario were determined by Mossbauer spectral and chemical extraction methods. The core locations lie on a transect across a boundary separating sediments displaying a crusty iron- and phosphorus-rich red layer located a few centimeters beneath the sediment-water interface from sediments displaying no such layer. Concentrations of nonantic organic phosphorus are relatively low at 18 displaying no such layer. Concentrations of nona-patite organic phosphorus are relatively low at the surfaces of the layered cores whereas the iron forms are quantitatively similar. It is proposed that the red layers prevent upward diffusion of pore-water ferrous and phosphate ions to the surface. The degree of phosphorus recycling within the top few centimeters of sediment can then be estimated. Approximately 0.035% nonapatite inorganic phos-phorus is carried into the anoxic zone. The data, combined with loadings of fine-grained sediment,

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indicate that Lake Ontario sediments have a net annual binding capacity of approximately 3500 metric tons of phosphorus, which compares with current loadings of approximately 8900 metric tons. This binding capacity supports current rec-ommended phosphorus loadings to Lake Ontario. (Author's abstract) W88-08286

DEVELOPMENT OF AN ENVIRONMENTAL DATA BASE FOR RIVERS, LAKES, AND RES-ERVOIRS.

Environmental Monitoring Systems Lab., Las

Vegas, NV.
For primary bibliographic entry see Field 7C.
W88-08295

STUDY OF THE UPTAKE BY DUCKWEED OF ALUMINUM, COPPER, AND LEAD FROM AQUEOUS SOLUTION, Louisiana State Univ., Baton Rouge. S. C. Mo, D. S. Choi, and J. W. Robinson. Journal of Environmental Science and Health (A) JESEDU, Vol 23, No. 2, p 139-156, February 1988

Descriptors: *Aquatic life, *Aquatic plants, *Plant physiology, *Path of pollutants, *Duckweed, Ac-cumulation, Absorption, Adsorption, Metabolism, Chlorophyll, Mortality, Plant pathology, Chemical properties, Aluminum, Copper, Lead, Hydrogen ion concentration, Ions.

The uptake of Al(3+), Cu(2+), and Pb(2+) from aqueous solutions by duckweed has been observed at ph 4.0, 4.5, and 5.0. The uptake of Pb(2+) was much faster than Al(3+) and Cu(2+). The uptake of Cu(2+) was suppressed by the presence of Pb(2+) and Al(3+). The proportion of metal uptake by duckweed was dependent on the metal concentration in the solution when only one kind. of metal ion was present. It was decreased by increasing concentrations of other metals in mixtures of solutions. The metal uptake by the duck-weed was always less than the loss of metal content in the relevant solution. This fact implied that the process of the uptake of metal ions by the duckweed may involve two stages. In the first, the metal is absorbed but then later it is adsorbed by metal is absorbed but then later it is adsorbed by the duckweed. The aluminum ion was more toxic than the copper ion at lower pH and higher con-centration, but the situation is reversed at higher pH. A possible explanation of toxicity of Cu(2+) and Al(3+) is that the Mg(2+) in chlorophyll was replaced by the Cu(2+) or Al(3+). This may lead the chlorophyll to lose its normal activity and kill the duckweed. (Author's abstract) W88-08296

DISTRIBUTION OF CADMIUM AND ZINC IN FIELD AND PADDY FIELD SOILS NEAR A ZINC SMELTER, Tokyo Univ. of Agriculture and Technology (Japan). Faculty of Agriculture. X. Xiam.

Journal of Environmental Science and Health (A) JESEDU, Vol 23, No. 2, p 156-157, February 1988. 5 tab, 14 ref.

Descriptors: *Cadmium, *Zinc, *Path of pollut-ants, *Toxic wastes, *Metal industry, *Soil chemis-try, Distribution, Oxidation-reduction potential, Hydrogen ion concentration, Paddy field, Smelt-ers, Iron, Manganese, Oxides, Rice.

Ten field and paddy field soils which had been polluted with exhaust dust and drainage from a zinc smelter were sequentially extracted so that Cd and Zn could be partitioned into five operationally defined geochemical fractions: exchangeable, bound to carbonate, bound to Fe-Mn oxide, bound to organic matter, and residual. The pH and oxidation-reduction condition of the soil and the pollution way could exert important influences on the distribution of the metals in the geochemical fractions. In field soils with low pH and inorganic Cd, 8, 19, 6, and 21% of the total Cd, 17, 8, 23, 9, and 43% of the total Zn were found in the exchangeable, carbonate, Fe-Mn oxide, organic and residual fractions, respectively. But in paddy field changeable, carbonate, Fe-Mn oxide, organic and residual fractions, respectively. But in paddy field

soils, the amount of Cd distributed in the exchangeable, carbonate, Fe-Mn oxide, organic and residual fractions was 51, 14, 29, 3, and 3%; Zn was 10, 13, 31, 12, and 34%. (Author's abstract) W88-08297

ADSORPTION OF CARCINOGENIC BENZ(A)PYRENE ON ACTIVATED SLUDGES, Perugia Univ. (Italy). Cattedra di Igiene. G. Morozzi, and F. Scardazza. Journal of Environmental Science and Health (A) JESEDU, Vol 23, No. 2, p 169-180, February 1988.

Descriptors: *Carcinogens, *Sludge, *Path of Pollutants, *Wastewater treatment, Adsorption, Activated sludge, Van der Waals forces, Benz(a)pyrene.

The rate and adsorption extent of carcinogenic benz(a)pyrene on activated sludges were studied. Benz(a)pyrene concentration was 3.2 microgram/1; solid concentration was 100 mg/l. A very rapid adsorption rate was observed. The adsorption (0.023 mg/g) was higher or of the same magnitude as that reported for inorganic particulate matter, but lower than that for activated carbon. The adsorption heat value (5.7 Kcal/mole) indicates the involvement of physical interactions (van der Waals forces) which could release the carcinogenic compound previously adsorbed in the environment. (Author's abstract) W88-08298

REMOVAL OF NICKEL (ID FROM WATER USING DECAYING LEAVES: EFFECTS OF PH AND TYPE OF LEAVES, Al-Najah National Univ., Nablus (Jordan). Dept.

Al-Najan National Univ., Natius (Jordan). Dept. of Chemistry.

For primary bibliographic entry see Field 5G.

W88-08299

STUDIES OF THE INFILTRATION AND MI-GRATION OF BRINE IN POTASH TAILINGS, Saskatchewan Univ., Saskatoon. Dept. of Civil En-

gineering.
D. K. H. Wong, and S. L. Barbour.
Canadian Journal of Civil Engineering CJCEB8,
Vol. 14, No. 5, p 638-648, October 1987. 10 fig. 4

Descriptors: *Path of pollutants, *Infiltration, *Mine wastes, *Waste disposal, *Brines, *Potash, Industrial waste, Infiltration, Fluid retention curves, Model studies, Flow theory, Theoretical analysis, Saskatchewan, Tensiometers, Infiltrometers, Solute transport, Performance evaluation, Saturated flow, Unsaturated flow.

A series of infiltration tests were conducted on the potash tailings pile at the Lanigan Division Potash Mine in Saskatchevan. These tests included single ring infiltrometer, shallow pit, open caisson and trench infiltration tests. The fluid retention curves for the tailings were established in the field using tensiometers and neutron probes to monitor in situ negative fluid pressures and fluid contents, respectively. These field-measured curves were then compared with the laboratory-evaluated fluid retention curves. The responses of the field instrumentation during the trench infiltration test were also compared with the results of a computer simualso compared with the results of a computer simu-lation of infiltration, which utilized the laboratory-evaluated fluid retention curve and the calculated evaluated fluid retention curve and the calculated permeability-suction curve as input data. The good agreement obtained between the measured and simulated field responses validates the application of saturated-unsaturated flow theory to the analysis of the flow of brine within the unsaturated tailings. It also verifies the accuracy of the fluid retention curve determined in the laboratory as well as the calculated permeability-suction curve. (Author's abstract) abstract) W88-08305

LEGIONNAIRES' DISEASE ASSOCIATED WITH A HOSPITAL WATER SYSTEM: A FIVE-YEAR PROGRESS REPORT ON CONTINU-OUS HYPERCHLORINATION,

Iowa Univ., Iowa City. Coll. of Medicine. For primary bibliographic entry see Field 5F. W88-08309

VADOSE ZONE CHARACTERIZATION OF LOW-PERMEABILITY SEDIMENTS USING FIELD PERMEAMETERS,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience. For primary bibliographic entry see Field 2F. W88-08310

MEASUREMENT OF CARBON DIOXIDE IN SOIL GASES FOR INDICATION OF SUBSURFACE HYDROCARBON CONTAMINATION,

Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV. Advanced Monitoring Systems Dept. For primary bibliographic entry see Field 2G. W88-08311

MONITORING THE VADOSE ZONE IN FRAC-TURED TUFF,

Earth Technology Corp., Long Beach, CA. For primary bioliographic entry see Field 7B. W88-08312

NITRATE IN THE INTERMEDIATE VADOSE ZONE BENEATH IRRIGATED CROPLAND, Nebraska Univ., Lincoln. Conservation

R. F. Spalding, and L. A. Kitchen. Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 89-95, Spring 1988. 4 fig, 15 ref.

Descriptors: *Groundwater pollution, *Water pol-lution sources, *Nonpoint pollution sources, *Soil contamination, *Nitrates, *Path of pollutants, Irri-gation, Leaching, Vadose zone, Nitrogen fertilizer, Cropland, Corn, Sampling, Solute transport, Pollu-tion load, Prediction, Fertilizers.

More than 1000 feet of fine-textured, unsaturated zone core beneath nitrogen-fertilized and irrigated farmland was collected, leached and analyzed for farmland was collected, leached and analyzed for nitrate-nitrogen. Fertility plots treated with 200, 300, and 400 lbs N/acre/yr accumulated significant quantities of nitrate-nitrogen in the vadose zone below the crop rooting zone. The average nitrate-nitrogen concentration approximately doubled with each 100 lbs N/acre/yr increment above the 100 lbs N/acre/yr increment above the 100 lbs N/acre/yr increment above the vadose zone beneath the crop rooting zone. In 15 years, the nitrate moved vertically at least 60 feet under independent corn producers' fields. Vadose zone sampling is effective in predicting future non-point nitrate-contaminated areas. (Author's abstract) stract) W88-08313

DESIGN OF LYSIMETER LEAK DETECTOR NETWORKS FOR SURFACE IMPOUNDMENTS AND LANDFILLS, In-Situ, Inc., Laramie, WY. Computer Technology

For primary bibliographic entry see Field 7A. W88-08315

OF VAPOR TRANSPORT SIMULATION THROUGH THE UNSATURATED ZONE: IN TERPRETATION OF SOIL-GAS SURVEYS, Hydrosystems, Inc., Falls Church, VA For primary bibliographic entry see Field 5A. W88-08316

SOLUTE TRANSPORT SIMULATION OF AQ-UIFER RESTORATION AFTER IN SITU URA-NIUM MINING,

Idaho Univ., Moscow. Coll. of Mines and Earth

For primary bibliographic entry see Field 4B.

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HUNTER REGION (AUSTRALIA) ACID RAIN

PROJECT,
Newcastle Univ. (Australia). Dept. of Geography.
H. A. Bridgman, R. Rothwell, P. Tio, and C. P.

Bulletin of the American Meteorological Society. BAMIAT, Vol 69, No. 3, p 266-271, March 1988. 6 fig, 2 tab, 24 ref.

Descriptors: *Acid rain, *Precipitation, *Climatology, *Water pollution sources, *Data collection, Chemical properties, Rainfall, Scasonal variation,

Field measurements for the Hunter Region Acid Rain Project were conducted as a major coopera-tive effort by the New South Wales State Pollution Control Commission the Electricity of Control Commission, the Electricity Commission of New South Wales, and the University of Newcastle in Australia. Rainfall collection using open and event-activated collectors at 32 sites occurred and event-activated collectors at 32 sites occurred for 44 events between October 1984 and March 1986, providing the most detailed acid-rain data base available for an Australian region. The structure and organization of the project are described and results of the pH measurements, which indicate volume-weighted pH averages between 4.9 and 5.6, depending on season and type of gauge, are presented (pH values > 5.0 were measured 37.3% of the time in the event-activated rainfall samples). The pH results indicate rainwater acidity in the Hunter Region is similar to that of remote areas of the world. (Author's abstract) W88-08320

FINITE ELEMENT MODELING OF FLOW IN A COAL SEAM WITH UNDERGROUND COAL GASIFICATION CAVITIES,

Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.

D. N. Contractor.

D. N. Contractor. Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 1-9, March 15 1988. 6 fig, 12 ref.

Descriptors: *Coal mines, *Model studies, *Computer models, *Groundwater, *Fate of pollutant, *Model studies, Simulation analysis, Finite element model, Coal gasification cavities, Wyoming, Mining, Hydraulics, Water quality.

A two-dimensional, finite element groundwater flow model was developed to study the movement of water in a coal seam in which large cavities were created by underground coal gasification or water in a coal seam in which large cavities were created by underground coal gasification burns. The burns extract natural gas from the coal without any environmental disturbance at the ground level. On completion of the burn, ground-water mixes with the products of combustion in the cavity and the pollutants move into the coal seam. Mathematical modeling was used to study the movement and fate of these pollutants with time. Water quality modeling has to be preceded by flow modeling to determine velocities as a function of time. The flow aspect of the problem was examined. A new code was developed because of the unique requirements of the model. The model utilizes linear triangles to discretize the coal seam in plan and takes into account unsteady flow, anisotropic media, internal boundary conditions imposed by the cavities and a time-varying domain of flow in plan. The model was applied to a series of underground coal gasification burns in Hanna, Wyoming, Estimates of the time of filling of the five cavities were obtained. Comparisons of measured and computed potential head are presented at different points in the coal seam. Flow modeling can thus be used to predict the movement of water can thus be used to predict the movement of water into and out of underground coal gasification cavities while the output of velocities is necessary for water quality modeling. (Author's abstract) W88-08323

ANALYTICAL SOLUTIONS FOR TWO-DI-MENSIONAL CHEMICAL TRANSPORT IN

Thessaloniki Univ., Salonika (Greece). School of Technology.

P. Latinopoulos, D. Tolikas, and Y. Mylopoulos. Journal of Hydrology JHYDA7 Vol. 98, No. 1/2, p 11-19, March 15 1988.

Descriptors: *Model studies, *Groundwater pollution, *Path of pollutants, *Waste disposal, Mathematical equations, Industrial wastes, Water pollution prevention, Differential equations, Aqu

A method of obtaining analytical solutions for chemical transport in two-dimensional aquifers was developed. Assuming a constant velocity field, linear adsorption, and first-order decay the solution is obtained by integrating the solution of a modified one-dimensional differential equation. The procedure is simple and straightforward and can be applied to various sets of initial and boundary conditions as long as the corresponding one-dimensional transport equation has an analytical solution. When the results obtained by this method were compared to the results obtained by a previously published method, they were almost identical. An idealized problem is presented in which cal. An idealized problem is presented in which two waste disposal schemes for effluents from a factory are compared. The results indicate that the analytical solutions obtained are useful in under-standing the mechanisms of chemical transport in porous media and in deriving estimates of potential aquifer pollution. (Hammond-PTT) W88-08324

INTERRELATION OF HYDRAULIC AND ELECTRICAL CONDUCTIVITIES, STREAM-ING POTENTIAL, AND SALT FILTRATION DURING THE FLOW OF CHLORIDE BRINES THROUGH A SMECTITE LAYER AT ELEVAT-FID PDESSI IDES ED PRESSURES.

Illinois Univ., Urbana. Dept. of Geology I. Demir.

Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 31-52, March 15 1988. 8 fig, 38 ref.

Descriptors: *Geophysics, *Electrical studies, *Path of pollutants, *Electrical conductivity, *Brines, *Hydrology, *Hydraulic conductivity, *Conductivity, *Geochemistry, Chemical properties, Streaming potential, Soil type, Sodium, Chloride, Calcium, Pressure distribution, Soil compactivity, *Conductivity, *Geochemistry, *Geochemistry,

Solutions of NaCl and NaCl-CaCl2 were forced through a clay plug made by compacting the 0.5-2.0 micrometer size fraction of Cheto montmorilonite. The initial concentration of NaCl solution was 1.10 molal, and that of NaCl-CaCl2 solution was 0.92 molal in NaCl and 0.075 molal in CaCl2. The thickness of the clay plug was 0.5 cm. Two experiments were carried out, one with the NaCl solution and one with the NaCl-CaCl2 solution. It experiments were carried out, one with the NaCl solution and one with the NaCl-CaCl2 solution. It took six to seven weeks to achieve constancy of effluent chemical composition and of streaming potential. Compaction pressure in these room temperature experiments was 34.5 MPa (5000psi), differential hydraulic pressure across the clay was 13.8 MPa (2000psi), and mean hydraulic pressure was 15.9 MPa (2000psi). These values of compaction pressure and mean hydraulic pressure are approximate for a depth of 1525 m in sedimentary basins. Hydraulic flow rate, streaming potential, and brine chemical composition were measured periodically until steady state. Electrical conductance of the clay plug was measured in the beginning and at the end of each experimental run. The presence of Ca(2+) in the brine resulted in lower hydraulic conductivity and streaming potential but slightly higher electrical conductivity. The electroviscous effect caused a significant reduction in the flow rate. The experimental results conform to the predictions of nonequilibrium thermodynamics, for both Na-Cl and Na-Ca-Cl systems, under these simulated subsurface conditions. Salt filtration efficiencies of 48% were measured. In the Na-Ca-Cl system, Na(+) was preferentially transported through the clay relative to Ca(2+). (Author's abstract) abstract) W88-08326

MONITORING OF RECHARGE WATER QUALITY UNDER WOODLAND, Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Soil and Groundwater.
G. J. W. Krajenbrink, D. Ronen, W. Van Duijvenbooden, M. Magaritz, and W. Wever. Journal of Hydrology JHYDA7, Vol. 98, No. 1/2,

p 83-102, March 15 1988, 6 fig. 6 tab. 20 ref.

Descriptors: *Nonpoint pollution sources, *Monitoring, *Forests, *Groundwater pollution, *Aeration zone, *Water quality, *Acid rain, *Path of ation zone, "Water quanty, "Acid rain, "Path of pollutants, Climatology, Precipitation, Monitoring, Soil water, Recharge water, Chemical properties, Root zone, Cropland, Groundwater recharge, Leachates, Aquifers, Agricultural watersheds.

The quality of groundwater in the water table zone and soil moisture below the root zone, under woodland, were compared with the quality of the regional precipitation. The water quality under forest shows evidence of the effect of atmospheric description of certain properties. deposition of acidic components (e.g. SO2) and ammonia volatilized from land and feed lots. Deammonia volatilized from land and feed lots. Detailed chemical profiles of the upper meter of groundwater under different plots of forest, at varying distances from cultivated land, were obtained with a multilayer sampler, using the dialysic cell method. Porous ceramic cups and a vacuum method were used to obtain soil moisture samples at 1.20 m depth under various types of trees, an open spot and arable land, for one year. The investigation took place in the recharge area of a pumping station with mainly mixed forest, downwind of a vast agricultural area with high ammonia volatilization and underlain by an ice-deformed squifer. zation and underlain by an ice-deformed aquifer. Very high NO3(-) concentrations were observed in very nigh NU3-): Concentrations were observed in soil moisture and groundwater under coniferous forest, especially in the border zone. This raises the question of the dilution capacity of recharge water under woodland in relation to the polluted groundwater under farming land. The buffering capacity of the unsaturated zone varies substantially; locally a low pH (4.5) was observed in groundwater. The large variability of leachate composition on different scales under a forest and the lesser but still simificant concentration differences in the ground-similary to the concentration differences in the groundsignificant concentration differences in the ground-water prove the importance of a monitoring system for the actual solute flux into the ground-water. (Author's abstract) W88-08329

DEUTERIUM AND OXYGEN-18 STUDIES IN GROUNDWATER OF THE DELHI AREA.

Panjab Univ., Chandigarh (India). Centre of Advanced Study in Geology. For primary bibliographic entry see Field 2F. W88-0832

TOXICITY AND CHEMICAL COMPOSITION OF URBAN STORMWATER RUNOFF. British Columbia Univ., Vancouver. For primary bibliographic entry see Field 5C. W88-08364

SOURCES AND SINKS OF NUTRIENTS IN A NEW ZEALAND HILL PASTURE CATCHMENT: I. STORMFLOW GENERATION, Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre. J. G. Cooke, and T. Dons. Hydrological Processes HYPRE3, Vol. 2, No. 2, p 109-122, April 1988. 7 fig, 3 tab, 29 ref, append.

Descriptors: *Storm runoff, *Water pollution sources, *Path of pollutants, *Surface runoff, *Catchment areas, *Nutrients, *Sinks, *Storm seepage, Pastures, Rainfall, Seasonal variation, Soil types, Hydrographs, Water quality management, Springs, Nitrates, New Zealand.

Stormflow generation was studied in a hill pasture catchment near Hamilton, New Zealand. Although rainfall was evenly distributed through the year, rainfall was evenly distributed through the year, stormflow was highly seasonal and >65% occurred during the winter. Three main processes contributing to stormflow were identified which could be related to soil type and physiographic position. On gleyed soils derived from rhyolitic colluvium, saturation overland flow was the dominant process. Hydrographs from "Whipkey' throughflow troughs also indicated that there was a subsurface response (saturated wedge) from this soil type. On steeper convex slopes, more permea-

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ble soils were derived from weathered greywacke. the soins were derived from weathered greywacke. The presence of ephemeral springs on the hills-lopes and direct observation during storm events indicated that storm runoff was generated as return flow from this soil. Nitrate concentrations from subsurface sources were 5-10 times higher than surface runoff. This difference was utilized in a density as united to the surface of the surface runoff. schemical mixing equation which partitioned storm-flow sources. This was compared with the storm-flow predicted from rain falling onto saturated areas. There was good agreement between the two models for winter-spring events with respect to the volumes of surface runoff predicted; however, the volumes of surface runoff predicted; nowever, the saturated areas model underestimated total stormflow. The results are discussed in terms of the potential for water quality management. (See W88-08366 through W88-08367) (Author's abstract)

SOURCES AND SINKS OF NUTRIENTS IN A NEW ZEALAND HILL PASTURE CATCH-MENT: II. PHOSPHORUS, Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre. J. G. Cooke.

G. Cooke. Hydrological Processes HYPRE3, Vol. 2, No. 2, p 123-133, April 1988. 5 fig, 4 tab, 24 ref.

Descriptors: *Catchment areas, *Nutrients, *Phos-Descriptors: "Catchment areas, "Nutrients, "Phosphorus, "Pertilizers, "Water pollution sources," Path of pollutants, "Pastures, "Surface runoff, "Riparian waters, "Water quality management, "Storm runoff, "Surface runoff, Seasonal variation, Rainfall, Soil type, Floods, New Zealand.

The management of the riparian zone has been suggested as a technique for controlling the amounts of P entering watercourses draining pasture catchments. A study was made of P entering a stream from various sources, with the object of providing a rational basis for the design of effective riparian management schemes. P entrained in surface runoff could account for virtually all of the P entering the stream during storms. About 20% of the annual P export from the catchment could be accounted for by direct aerial input of P to the The management of the riparian zone has been the annual P export from the cateriment could be accounted for by direct aerial input of P to the stream during autumn fertilizer topdressing. More than 55% of the P was exported from the cateriment as particulate P. Stream sediment had higher P sorption capacities, and were enriched with P relative to the soils from which they were derived. There was a pronounced seasonal variation in sediment enrichment which could be predicted by the logarithm of the rainfall since fertilizer topdressing (LNFERT) and flood intensity. The amount of P lost in streamflow during any flood event was predicted by peak flow, 7-day antecedent peak flow and LNFERT. About 40% of the 1.3 kg P/ha exported during 1981 ocurred in 4 storms with recurrence intervals of more than three months. From a P budget compiled from 9 events it was hypothesized that the streams acted as a net sink for P at baseflow and low-medium intensity floods but was a source of P at higher flood intensities. P closes from hill pasture catchments could be reduced by avoidance of direct application of P fertilizer to the stream channels, and by fencing out stock from seasonally saturated areas during presides of saturation. The attention uncertainty of the accounted for by direct aerial input of P to out stock from seasonally saturated areas during periods of saturation. The ultimate success of the latter technique would depend on whether buffer vegetation could retain accumulated P during extreme storm events. (See also W88-08365 and W 08367) (Author's abstract) W88-08366

SOURCES AND SINKS OF NUTRIENTS IN A NEW ZEALAND HILL PASTURE CATCH-MENT: III. NITROGEN.

MENT: III. NITROGEN, Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre. J. G. Cooke, and A. B. Cooper. Hydrological Processes HYPRE3, Vol. 2, No. 2, p 135-149, April 1988. 7 fig, 6 tab, 34 ref.

Descriptors: "Water pollution sources, "Path of pollutants, "Nitrogen, "Pastures, "Catchment areas, "Nutrients, "Nitrogen compounds, "Nitrates, "Surface runoff, "Water quality management, "Storm runoff, "Surface runoff, Nitrification. Denitrification, Plants, Seepage, Rainfall, Soil type, Floods, New Zealand.

A study was made of the N inputs to, and exports A study was made of the N inputs to, and exports from, a stream draining a pasture catchment near Hamilton, New Zealand, in order to plan measures for minimizing N losses to natural waters. An estimated 7 kg N/ha was exported from the catchment during 1981 of which 86% was in reduced forms (Kjeldahl-N, TKN) and the remainder as nitrate-N. Virtually all of the reduced N inputs came from saturated overland flow whereas nitrate-N inputs, were dominantly subsurface detrate-N inputs were dominantly subsurface de-rived. The TKN exported by individual storm rived. The TKN exported by individual storm events could be predicted from peak flow and from the peak flow rate in the 7 days preceding the storm. A TKN balance for 8 events showed that except for large floods the stream system was a net sink for TKN. During large floods, scouring of the organic rich seepage areas resulted in the stream system itself being a net source of TKN. Microbial assays for nitrification and denitrification indicated that the main nitrate source was the well-accepted. assays for intrincation and continuation indicated that the main nitrate source was the well-aerated greywacke and ash soils and that the permanently saturated seepage zones were a significant nitrate sink. An in-stream nitrate addition experiment showed that up to 20 mg N/sq m/h was removed from the stream. Simultaneous measurements of in situ denitrification demonstrated that only about 1% of this removal could be accounted for by denitrification. Plant uptake was probably responsible for the remainder. Retention of near-stream seepage rates is suggested as a measure for miniseepage rates is saggested as a measure for limiting mitrate-N expert, while removal of stock from seasonally saturated areas during periods of saturation should reduce soil loss and hence TKN inputs to the stream. (See W88-08365 thru W88-08366) (Author's abstract) W88-08367

EFFECT OF SEWAGE-SLUDGE ON THE HEAVY METAL CONTENT OF SOILS AND

Nova Scotia Agricultural Coll., Truro. For primary bibliographic entry see Field 5E. W88-08372

FACTORS INFLUENCING ENTRY OF PESTI-CIDES INTO SOIL WATER,

Rothamsted Experimental Station, Harpenden P. H. Nicholls.

Pesticide Science PSSCBG, Vol. 22, No. 2, p 123-137, 1987. 11 fig, 3 tab, 23 ref.

Descriptors: *Pesticides, *Soil water, *Ground-water, *Pollution, *Fate of pollutants, *Path of pollutants, Leaching, Physicochemical properties, Hydrogen ion concentration, Organic acids, Anions, Weather, Temperature, Rainfall, Subsoil,

Leaching of pesticides and hence the risk of con-tamination of groundwater depends on the phys-icochemical properties of the pesticide, the proper-ties of the soil and the weather. Lipophilicity is the most important physicochemical property influ-encing the movement of unionized pesticides through soil. Water solubility is usually only an important factor in leaching for a few moderately polar solids with high melting points. Organic matter content is the most important property of polar sonus with nigh menting points. Organic matter content is the most important property of the soil for unionized pesticides while the mobility of weak acids depends on soil pH. Permanent anions and weak acids can be very weakly ad-sorbed and hence might easily reach groundwater. sorbed and hence might easily reach groundwater. Applications in autumn are more likely to reach groundwater than those in spring because soil temperatures are low and rainfall exceeds evaporation in winter, enabling mobile pesticides to penetrate to subsoils where degradation rates can be very slow. Concentrations of pesticide in water entering subsoils cannot be reliably simulated to an accuracy of better than an order of magnitude because the complex patterns of water flow and the slow diffusion processes of the pesticide are insufficient. diffusion processes of the pesticide are insufficiently understood. The consequences of applying a mobile pesticide to soil where drainage is impeded or where the water table is near the surface need to be anticipated before it is registered for treatment of the soil. (Author's abstract) W88-08374

HOW TO DEAL WITH GROUNDWATER CONTAMINATION,

bibliographic entry see Field 5G.

SURFACE AND DOWNHOLE GEOPHYSICAL TECHNIQUES FOR HAZARDOUS WASTE SITE INVESTIGATION,

Technos, Inc., Miami, FL. R. C. Benson.

Hazardous Material Control, Vol. 1, No. 2, p 10-18, 53-60, March-April 1988.

Descriptors: *Water pollution sources, *Pollutant identification, *Borehole geophysics, *Hazardous materials, *Waste dumps, *Underground waste disposal, *Pollutants, Geophysics, Radar, Electromagnetics, Gravity, Resistivity, Seismographs, Metal detectors, Magnetometers, Organic vapor analysis, Boreholes.

Traditional approaches to subsurface field investi-Traditional approaches to subsurface field investi-gations at hazardous waste sites - drilling, boring, and installing monitoring wells - can result in an incomplete or even erroneous evaluation of site conditions. The placement of wells has traditional-ly been done mainly by educated guesswork, and is often based on invalid assumptions concerning the uniformity of subsurface conditions. Investigators may decide to drill more wells to improve accura-cy; this is time-consuming and expensive. In addi-tion, at some sites there also are safety risks associ-ated with drilling into unknown buried materials. cy; this is time-consuming and expensive. In adur-tion, at some sites there also are safety risks associ-ated with drilling into unknown buried materials. Another way to increase the accuracy of such investigations is an integrated systems approach that makes use of geophysical as well as other techniques. This approach uses both direct sam-pling and geophysical techniques include quality data with fewer borings or wells, at lower overall cost. The geophysical techniques include ground-penetrating radar, electromagnetics, resis-tivity, seismic and gravity methods, metal detec-tion, magnetometry, organic vapor analysis, and a wide range of downhole techniques. The surface geophysical methods are generally used as recon-naissance tools to cover an area rapidly and to focus attention on problem areas. This allows boring and monitoring well locations to be selected naissance tools to cover an area rapidly and to focus attention on problem areas. This allows boring and monitoring well locations to be selected with a high degree of confidence that they will produce representative samples. (Sand-PTT) W88-08386

LAND DISPOSAL.

Wisconsin Univ.-Madison For primary bibliographic entry see Field 5E. W88-08388

CONCENTRATIONS OF PCBS, DDTR, AND METALS IN FISH FROM TELLICO RESER-

VOIR,
Tennessee Valley Authority, Knoxville. Div. of
Air and Water Resources.
D. L. Dycus, and G. D. Hickman.

D. L. Dycus, and G. D. Hickman. Available from the National Technical Information Service, Springfield, VA 22161, as DE87-900852. Price codes: A03 in paper copy, A01 in microfiche. Report No. TVA/ONRED/AWR-87/25, November 1986. 34 p, 6 fig, 6 tab, 11 ref, append.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *DDT, *Heavy metals, *Tellico Reservoir, *Tissue analysis, *Fish, Catfish, Bass, Carp, Chromium, Nickel, Mercury, Reservoirs.

The Tennessee Valley Authority Reservoir Water Quality Management Plan for Tellico Reservoir has as its objective the prevention of deterioration in water quality while allowing reasonable development of the reservoir and surrounding lands. A study was initiated in autumn 1985 to examine levels of selected contaminants in composited flesh from channel catfish, largemouth bass, and carp and livers from channel catfish. Fish were collected in unstream of, and downstream of the area of and inversion channer cannish. Fish were consected in, upstream of, and downstream of the area of the reservoir where industrial development is expected to occur. Results showed levels of DDTr were low in all species from all locations. PCB levels were low in largemouth bass and carp but not in channel catfish. Four of the 12 composite

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channel catfish samples exceeded the FDA toler-ance of 2.0 micrograms/gm (maximum of 3.2 mi-crograms/gm) and only one sample had a level
 1.0m micrograms/gm. There was no statistically significant difference in PCB levels among the four significant difference in PCB levels among the four sample locations, although there was a tendency toward higher levels at downstream locations. Most metals occurred at low or nondetectable levels. Only chromium, nickel, and mercury oc-curred at levels worthy of attention. Chromium and nickel levels were mich higher than normally reported. Mercury levels were not high enough to warrant concern; however, the distribution of mercury levels in the reservoir coupled with the distri-bution of several other metals indicate fish from the Tellico River arm may be substantially differ-ent from fish from the rest of the reservoir. It is recommended that catfish analyzed for PCBs also be analyzed (both flesh and livers) for selected priority pollutant metal possibility. (Lantz-PTT) W88-08392 pollutant metals to better evaluate this

ACUTE TOXICITY OF TRIBUTYLTINS AND TRIBUTYLTIN LEACHATES FROM MARINE ANTIBIOFOULLING PAINTS, California Univ., Oakland. Naval Biological Lab. For primary bibliographic entry see Field SC. W88-08411

COMPARISON OF LEACHING TESTS AND STUDY OF LEACHING MECHANISMS, Democritos Nuclear Research Center, Athens

(Greece). . G. Amarantos, K. G. Papadokostaki, and J. H.

Petropoulos. Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-702437. Price codes: A03 in paper copy, A01 in microfice. Report No. DEMO 85/9, October 1985. 34 p, 14 fig, 6 tab, 12 ref. Greek AEC-Euratom Contract No. WAS-305-83-15-CR-B.

Descriptors: *Waste disposal, *Radioactive wastes, *Water pollution sources, *Leaching, *Cesium, *Strontium, *Cement, Leachates, Carbon dioxide, Temperature, Chemical analysis, Model studies.

The leaching kinetics of Cs(+) and Sr(++) embedded in cement, were studied as Cs3SO4 and CrSO4, with particular attention on: (1) the comparative evaluation of leaching in stagnant, stirred and continuously flowing (modified Soxhlet) water, (2) the effect of atmospheric CO2 on elution, and (3) the effect of temperature changes during leaching. In addition, model kinetic studies were carried out using cellulose acetate incorporating SrSO4, CaSO4 or NaCl. Cs leaching rates were ot significantly affected by the leaching method or by the presence of atmospheric CO2. The embedded Cs exists in relatively easily leachable and less readily leachable (most probably located bedded Cs exists in relatively easily leachable and less readily leachable (most probably located within the gel regions) forms. Elution of Sr is retarded by stagnant and infrequently renewed leachant and by the presence of atmospheric CO2. Leaching with continuously flowing water, which tends to minimize both these effects, gave the highest elution rates. The observed elution kinetics in the case of cellulose acetate-CASO4 or SrSO4 conform to the Higuchi model, but a more elaborate theory is needed for the cellulose acetate-NaCl system. (Lantz-PTT) W88-08413

WATER POLLUTION BY FERTILIZERS AND

PESTICIDES.
Organization for Economic Co-Operation and Development, Paris (France).
Organization for Economic Cooperation and Development, Paris, France. 1986. 144 p.

Descriptors: *Water pollution sources, *Fertilizers, *Pesticides, *Nitrates, *Agricultural chemicals, Path of pollutants, Agriculture, Soil contamination, Water pollution, Water pollution effects, Insecticides, Fungicides, Phosphorus, Leaching, Eutrophication

Two reports on diffuse sources of agricultural water pollution produced for the Environment

Committee of the Organization for Economic Development, (OECD) by its Water Management Policy Group are presented. One discusses pollution by fertilizers and animal wastes, the other pollution by pesticides. The basis of each report was work done by a panel of experts nominated by Member countries. Since agricultural experts contibuted to this work, the interests of agriculture were taken into account. Nevertheless, the problems of water pollution are analyzed from the perspectives of water management; they take the view that agricultural activities need to take into account environmental costs borne by society, and that this requires some adaptation of current agricultural practices. The problems which are most prevalent in OECD countries, as a result of intensi-Committee of the Organization for Economic Decultural practices. The problems which are most prevalent in OECD countries, as a result of intensification of agriculture and high use of synthetic fertilizers and animal wastes, are increased nitrate concentrations in drinking water and eutrophication. Nitrate concentrations in ground and surface water have been rising rapidly in the past few years and, in various areas are approaching or exceeding international standards for drinking water. Diffuse sources of pollution by pesticides may occur in any of the three environmental media: soil, air or water. Because pesticide use in media: soil, air or water. Because pesticide use in any one of these media will necessarily have effects on the other two, the report to some extent tran-scends these categories, and consider pesticides and controls over their use in the widest sense. The term pesticide is taken to include not only the general plant protection products, but also a number of other biocides and products used to protect food in storage, i.e., acaricides, fungicides, insecticides, molluscicides, nematicides and roden-ticides. (Lantz-PTT) W88-08415

ESTIMATION OF THE PRECIPITATION RATE OF ANTHROPOGENIC SO2 IN THE GREATER SAO PAULO REGION (ESTIMATIVA DA TAXA DE PRECIPITACAO DE SO2 ANTROPOGENICO NA GRANDE SAO PAULO), Instituto de Pesquisas Espaciais, Sao Paulo

(Brazil). C. M. Espirito Santo, and L. M. Moreira-

Nordemann. Available from the National Technical Information Service, Springfield, VA. 22161, as N87-28234. Price codes: A02 in paper copy, A01 in microfiche. Instituto de Pesquisas Espaciais Report No. INPE-4264-PRE/1137, October 1987. 15 p. 2 fig. 1 tab, 10 cef.

Descriptors: *Model studies, *Sao Paulo, *Water pollution sources, *Brazil, *Acid rain, *Sulfates, Mathematical models, Precipitation, Mathematical

Using the CETESB data on the SO2 concentration and emission rate over the Greater Sao Paulo region, an annual deposition rate of the pollutant was estimated. A pollutant deposition numerical model was used for to obtain these estimates. The model, its application, as well as its inherent limita-tions, are discussed in this work. (Author's abstract) W88-08416

TRANSPORT OF ORGANIC CONTAMINANTS IN COASTAL PLAIN SEDIMENTS, Savannah River Lab., Aiken, SC. Environmental

Sciences Div B. B. Looney.

Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-006390. Price codes: A06 in paper copy, A01 in microfiche. Report No. DP-MS-86-149, 1985. 21 p, 5 fig, 1 tab, 21 ref. DOE Contract No. DE-AC09-76SR00001

Descriptors: *Groundwater pollution, *Path of pollutants, *Organic compounds, *Sediments, *Coastal plains, *Groundwater movement, Aeration zone, Cleanup, Solute transport, Sorption, Fate of pollutants, Model studies.

The behavior of hydrophobic organic substances in the subsurface environment (saturated and unsaturated zones) is governed by water flow, sorp-

tion interactions, dissolution, dispersion, and degra-dation. Estimation of the nature and extent of contamination as a function of time requires that contamination as a function of time requires that these phenomena be characterized for the soil-compound-solution system of interest. There is little data related to these processes and correla-tions from the literature have often resulted in poor tions from the literature have often resulted in poor estimations. The objectives of the work described here are: (1) To present a model of organic trans-port in coastal plain sediments and discuss an appli-cation of the model to a specific site; (2) To outline the caveats and limitations of the model (especially in terms of application to 'complex organic mix-tures'). The two primary caveats which require attention are observed sorbent concentration ef-fects and distribution coefficient and the observed attention are observed softenet concentration effects on distribution coefficient and the observed effect of organic cosolvents on the distribution coefficient. Neglect of these factors, as well as the scale effects in dispersion, may be responsible for poor estimations of the transport and fate of organics based on correlations from laboratory studies; and (3) Outline ongoing and future work which will aid in addressing the mechanisms of organic transport in the environment. (Lantz-PTT) W88-08417

ENVIRONMENTAL RADIOACTIVITY LEVELS, BROWNS FERRY NUCLEAR PLANT: ANNUAL REPORT - 1986.

Available from the National Technical Information Service, Springfield, VA. 22161, as DE37-900848. Price codes: A04 in paper copy, A01 in microfiche. Report No. TVA/PUB-87/15, April 1986. 56 p, 12 fig, 31 tab.

Descriptors: *Water pollution sources, *Radioactivity, *Nuclear powerplants, *Browns Ferry, *Alabama, Radioisotopes, Gamma radiation, Alpha radiation, Beta radiation, Beryllium radioisotopes, Potassium radioisotopes, Environmental effects, Bismuth radioisotopes, Lead radioisotopes, Radium radioisotopes, Monitoring.

The Browns Ferry Nuclear Plant (BFN), operated by the Tennessee Valley Authority (TVA), is located on a site owned by TVA containing 840 acres of land in Limestone County, Alabama, bounded on the west and south by Wheeler Reservoir. Unit 1 began commercial operation on August 1, 1974. Unit 2 on March 1, 1975 and Unit 3 in January, 1977. The plant has been shut down 3 in January 1977. The plant has been shut down since March 1985. The preoperational environmental radiological monitoring program established baseline data on the distribution of natural and manmade radioactivity in the environment near the plant site. Radiological Control (Office of Nuclear Power) and the Office of Natural Resources and Powery and the Office of Natural Resources and Economic Development carried out a sampling program, at locations of the atmospheric and terrestrial monitoring stations. Alpha and beta analyses were performed on Beckman Low Beta II low background proportional counter, or a Tennelec LB-5100. Gamma spectral analyses were performed with a Nuclear Data (ND) Model 6700 multichangle analyser system utilizing commanium multichannel analyzer system utilizing germanium detectors. Many of the isotopes identified by ger-manium spectral analysis are naturally occurring or manum spectral analysis are naturally occurring or, naturally produced radioisotopes, such as 7-Be, 40-K, 212-Bi, 214-Bi, 212-Pb, 214-Pb, 226-Ra, etc. Lower limits of detection for radionuclides identified by Ge(Li) analysis were calculated for each analysis. It is concluded that there were no measurable increases in the exposure to members of the analysis. It is concluded that there were no measurable increases in the exposure to members of the general public attributable to the operations of BFN. Indications of the presence of small quantities. ties of fission and activation products have been seen, especially in aquatic media. Although the levels reported sometimes exceed the values re-ported at the corresponding control stations, they are similar to levels reported in samples collected in conjunction with preoperational monitoring program being conducted by TVA at nuclear plant construction sites upstream from Browns Ferry. (Lantz-PTT)

SOLVING HAZARDOUS WASTE PROBLEMS: LEARNING FROM DIOXINS.

International Technology Corp., Marinez, CA. For primary bibliographic entry see Field 5E.

Group 5B-Sources Of Pollution

GLOBAL DISTRIBUTION OF POLYCHLORI-NATED DIOXINS AND DIBENZOFURANS, Umea Univ. (Sweden). Dept. of Organic Chem

try. C. Rappe. IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Wash-ington, DC. 1987. p 20-33, 6 ref, 30 ref.

Descriptors: *Polychlorinated biphenyls, *Dioxins, *Fate of pollutants, *Contamination, *Path of pol-lutants, Pollution load, Fish, Human physiology, Incineration, Hazardous wastes, Chemical wastes, Soil analysis, Spatial distribution, Global distribution, Distribution patterns

Polychlorinated dioxins and dibenzofurans have been identified in technical products and pesticides, been identified in technical produces and po-most of which are not very widely used today. Other sources are incinerators of various types like municipal solid waste incinerators, but also hazard-ous waste incinerators and industrial incinerators. Polychlorinated dibenzodioxins (PCDDs) and pol-ychlorinated dibenzofurous (PCDFs) have also been identified in exhausts from cars running on leaded gasoline with halogenated additives. Back-ground levels of PCDDs and PCDFs have been identified in fish and other aquatic organisms from ground levels of PCDDs and PCDFs have been identified in fish and other aquatic organisms from the Great Lakes and the Baltic Sea, and also in human adipose tissue samples from USA, Canada, Sweden, Japan and Vietnam as well as in samples of breast milk from Sweden, Denmark, West Germany, the Netherlands, Yugoslavia and Vietnam. The isomeric pattern in all these biological samples is very similar. (See also W88-08431) (Author's

NATIONAL DIOXIN STUDY,

Environmental Protection Agency, Washington, DC

P. E. des Rosiers. IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society Wast. from Dioxins. American Chemical Society, Washington, DC. 1987. p 34-53, 1 fig, 4 tab, 10 ref.

Descriptors: *Fate of pollutants, *Dioxins, *Contamination, *Path of pollutants, *Comprehensive planning, *Administrative regulations, *Environmental policy, Data acquisition, Chemical wastes, Hazardous wastes, Soil analysis, Fish, Spatial distribution, Distribution patterns.

This report presents the results of EPA's two-year, nationwide investigation of potential 2,3,7,8-TCDD (dioxin) contamination. The EPA established seven categories (tiers) of study ranging from the most probable contamination to the least. The majority of dioxin contamination at Tier 1, 1a, 2 and 2a sites remained consists. Some 2,3,78. 2 and 2a sites remained on-site. Some 2,3,7,8-TCDD concentrations were as high as 356 ppm. Most sites, however, had TCDD levels in soil in the ppb range. In fish samples from nearby lakes and streams, 2,3,7,8-TCDD was measured in terms of ppt. Only two Tier 3 sites were extensively contaminated, with the extent of contamination contaminated, with the extent of contamination limited to one or two soil samples above 1 ppb. Dioxins (CDDs) and furans (CDFs) were present in stack emissions from all sources tested in Tier 4 and most of the combustion sources reported in the literature. CDD and CDF emissions from some sources have estimated risks to the most exposed individual of 10 to the minus 5th power or more; these sources include a secondary copper smelting facility, a sewage sludge incinerator, and some municipal incinerators. At Tier 5 pastureland, rice field, and sugarcane sites, 2,3,7,8-TCDD levels in contaminated soils ranged from 0.6 to 564 ppt, with 67% below 5 ppt; levels in fish filets were between 8 and 23 ppt. At the three Tier 6 regionally selected sites, none was extensively contaminated. At one site, however, groundwater contaminated. ty selected sites, none was extensively contamination was found at the 0.07-0.10 ppt level in three samples. The Tier 7 investigation established the prevalence of 2,37,8-TCDD in the environment: 2,3,7,8-TCDD was detected infrequently and at very low levels in background soil samples with the highest level being 11.2 ppt. (See also W88-08431) (Author's abstract)

W88-08434

2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN: ENVIRONMENTAL CHEMISTRY, Nevada Univ., Reno. Dept. of Biochemistry. G. C. Miller, and R. G. Zepp. IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Washington, DC. 1987. p 82-93, 48 ref.

Descriptors: *Dioxins, *Fate of pollutants, *Chemical properties, *Path of pollutants, *Degradation, *Biodegradation, *Ecological effects, Toxicity, Risk, Hazardous materials, Literature review.

For molecules of its size and molecular weight, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8 TCDD) is one of the most toxic, least water solu licibility is one of the most countries water southel, least volatile, and most resistant to thermal and biological transformations. The combination of these properties has presented a challenging problem in assessing human hazards ascribable to TCDD because, although exposure concentrations are often low, the time frame for transport and countries are often low. are often low, the time transfer transport and most degradative processes in the environment is generally long. Under normal environmental conditions the only transformation process that is fairly rapid for dioxins is photolysis. (See also W88.08431) (Author's abstract)

PERSISTENT TOXIC ORGANIC WASTE: IS DESTRUCTION NECESSARY.

Eco Logic, Inc., Acton (Ontario) D. J. Hallett.

In: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Washington, DC. 1987. p 94-104, 3 tab, 24 ref.

Descriptors: "Waste disposal, "Toxicity, "Toxic wastes, "Chemical wastes, "Chlorinated hydrocarbons, "Great Lakes, "Pollution load, "Degradation, "Path of pollutants, "Ecological effects, Municipal wastes, Leachates.

Persistent toxic chemicals are now ubiquitous throughout the global biosphere. Environmental processes such as long-range transport through the atmosphere play a major role in creating this global dispersion. They are also the major exposure route to the human species through the terrestrial food web. Hazard and risk assessment associated with persistent contaminants must focus on dynamics throughout the whole ecosystem and total human exposure. Best available or best practicable treatment processes for wastes that contain persistent contaminants must be evaluated in terms of ecosystem exposure rather than providing diversions. Examples include the diversion of contaminants from an aquatic effluent into sewage sludge nants from an aquatic effluent into sewage sludge that is then either incinerated at low temperature or land farmed; both of these methods allow volaof land latrined, out of these methods and working tritization into atmosphere. The adoption of leading limits versus acceptable concentrations derived by dilution of persistent toxic substances is necessary. This paper considers the chemical dynamics of persistent organochlorine contaminants in the Great Lakes ecosystem, the major sources, present waste treatment, and the total ecosystem exposure to the human species. (See also W88-08431) (Author's abstract) W88-08436

CHEMISTRY OF ACID RAIN: SOURCES AND

CHEMISTRY OF ACID RAIN: SOURCES AND ATMOSPHERIC PROCESSES.
Allied-Signal, Inc., Des Plaines, IL. Engineered Materials Research Center.
American Chemical Society, Washington, DC. ACS Symposium Series No. 349. Based on a symposium sponsored by the Divisions of Petroleum Chemistry, Inc., Nuclear Chemistry and Technology, Environmental Chemistry, and Fuel Chemistry at the 191st Meeting of the American Chemical Society, New York, NY, April 13-18, 1986. 1987. 337 p.

Descriptors: *Water chemistry, *Chemistry of precipitation, *Acid rain, *Air pollution effects, *Cloud physics, *Ozone, *Sulfur compounds, *Nitrates, Deposition, Pollution load.

Acid rain is a popular term that describes an aspect of a large problem, that of acid deposition. Despite advances in our understanding, large gaps in our knowledge of acid rain still exist. This book assists knowledge of acid rain still exist. This book assists in filling these gaps, and is grouped into seven sections: General, Receptor Models, Cloud Chemistry and Physics, Kinetics, Wet and Dry Deposition, Experimental Methods, and Fundamental Processes. Specific chapter topics include subcontinental air pollution phenomena, hybrid receptor models, SO2 oxidation by hydrogen peroxide, pollutant deposition in radiation fog, and acid clusters. Additional chapter subjects include accommodation coefficients of ozone and SO2; spectroscopic identification of gas-phase reaction products; and sulfur, halogens, and heavy metals in urban summer rainfall. (See W88-08443 thru W88-08469) (VerNooy-PTT) (VerNooy-PTT) W88-08442

DECADE OF ACID RAIN RESEARCH,

Maryland Univ., College Park. Dept. of Chemis-

G. E. Gordon.

IN: The Chemistry of Acid Rain: Sources of At-mospheric Processes. American Chemical Society, Washington, DC. 1987. p 2-9, 24 ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Deposition, *Model studies, *Future planning, Regional planning, Sulfur compounds, Water pollution control, Data collections.

Much progress has been made in our understand-ing of the sources, formation and deposition of acid ing of the sources, formation and deposition of actual and sulfate. Large field studies can be conducted with good quality control of analyses and data. In the gas phase, OH radicals are known to capable of converting SO2 to sulfate fast enough to be important. Rates for H2O2, O3 and O2 in cloud droplets. converting SUZ to sulfate fast enough to be important. Rates for H2O2, O3 and O2 in cloud droplets are fast under certain conditions. However, serious gaps in our knowledge still exist, especially methods for measuring and predicting dry deposition and estimates of the supply of reactants to active cloud systems. A focal point for development of the U. S. control strategy is the Regional Acid Deposition Model (RADM). Uncertainties in some features of the model are likely to be so large that it may not provide credible predictions in a time soon enough to be useful to legislators or regulators. Hybrid receptor models may be able to provide some answers for sulfur species more quickly, although RADM should ultimately yield more detailed predictions for more species. Many problems attributed to acid rain, especially damage to trees at high altitudes, may be largely due to some other ionic species, e.g., H2O2 or O3. (See also W88-08442) (Author's abstract) W88-08443

SUBCONTINENTAL AIR POLLUTION PHE-

Nevada Univ. System, Reno. Desert Research Inst. G. M. Hidy.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 10-27, 7 fig, 3 tab, 11 ref.

Descriptors: *Air pollution, *Sulfates, *Nitrates, *Chemistry of precipitation, *Acid rain, Regional analysis, Spatial distribution, Temporal distribution, Deposition, Rainfall distribution.

This paper discusses aspects of the accumulating body of observation characterizing deposition of airborne acid forming substances. Of particular interest are sulfur and nitrogen oxides species. The focus of the observations and interpretation is on subcontinental (or regional) scale phenomena extending over areas of 1,000,000 sq km. Spatial and temporal distributions of ambient sulfur oxide (or sulfate) and nitrogen oxide (or nitrate) concentrations and precipitation chemistry are summarized as they reflect dry and wet deposition. Comparisons are given between conditions in the eastern and western United States. The importance of variability in deposition exposure, within year and from year-to-year, is outlined. Evidence of linkage between source emissions and receptor measure-

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ments is included to complete the discussion. (See also W88-08442) (Author's abstract) W88-08444

ACID DEPOSITION AND ATMOSPHERIC CHEMISTRY AT ALLECHENY MOUNTAIN, Ford Motor Co., Dearborn, MI. Research Staff. W. R. Pierson, W. W. Brachaczek, R. A. Gorse, S. M. Japar, and J. M. Norbeck.

IN: The Chemistry of Acid Rain: Sources of Attentional Society Proceedings of Proceedings of Society.

mospheric Processes. American Chemical Society, Washington, DC. 1987. p 28-38, 1 fig. 4 tab, 23 ref.

Descriptors: *Chemistry of precipitation, *Atmospheric chemistry, *Acid rain, *Nitrates, *Sulfates, Deposition, Air pollution, Dew, Fog, Allegheny Mountain PA.

In August, 1983, members of the Research Staff of Ford Motor Company carried out a field experiment at two rural sites in southwestern Pennsylvania involving various aspects of the acid deposition phenomenon. This report focuses on the wet (rain) deposition during the experiment, as well as the relative importance of wet and dry deposition processes for nitrate and sulfate at the sites. The characteristics of 17 rain events are summarized and compared to dew samples and one settled characteristics of 17 rain events are summarized and compared to dew samples and one settled fogwater sample. Cumulative amounts of various ions deposited per unit area are reported, as well as estimations of wet and dry acid, nitrate, and sulfate deposition budgets at Allegheny Mountain. The results employing daytime dry deposition estimates from the surrogate collectors are given in Table 4; these estimates presuppose that the five days are representative. While rain accounted for some 60% of the nitrate deposition, dry deposition of HNO3 in the absence of dew appears also to be important. For sulfate deposition, rain is again the dominant medium; however, the dry deposition of SO2 may also be important. The contributions of dry-deposited acrosol nitrate and sulfate were small (about 5%) at the site. If we suppose that SO2 is tantamount to H2SO4 in acidifying potential, on grounds that SO2 readily oxidizes to H2SO4, and if we recall that the nitrate and sulfate in the rain/dew/fog samples can be regarded as mostly HNO3 we recall that the nitrate and sulfate in the rain/dew/fog samples can be regarded as mostly HNO3 and H2SO4, then the total strong acid deposited in the experiment can be apportioned roughly as follows: 47% = H2SO4 in rain (34% SO2 scavenging, 13% aerosol sulfate scavenging); 23% = SO2 dry deposition without dew; 16% = HNO3 in rain; 11% = HNO3 dry deposition without dew; 63 and 3% = HNO3 and H2SO4 in fog and dew. (See also W88-08442) (VerNooy-PTT)

WESTERN ATLANTIC OCEAN EXPERIMENT, Virginia Univ., Charlottesville. Dept. of Environ-mental Sciences.

mental Sciences.
J. N. Galloway, T. M. Church, A. H. Knap, D. M.
Whelpdale, and J. M. Miller.
IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society,
Washington, DC. 1987. p 39-55, 6 fig, 3 tab, 21 ref.

Descriptors: *Chemistry of precipitation, *Fate of pollutants, *Path of pollutants, *Advection, *Atlantic Ocean, *Air pollution, *Nitrates, *Sulfates, *Atmospheric physics, *Acid rain, Air pollution effects, Trace metals, Organic compounds, Bermuda, Delawate.

The Western Atlantic Ocean Experiment (WATOX) investigates the flux and fate of sulfur, nitrogen, and trace-metal and trace-organic compounds eastward from North America. Using a variety of sampling platforms (ships, aircraft, islands), samples of gases, aerosols, and precipitation have been used to determine the impact of North America on atmospheric chemical cycles of the western Atlantic Ocean. This paper provides an overview of the results obtained since WATOX began in 1980. Bermuda was an ideal sampling platform for air that, at times, was directly impacted by anthropogenic uncertainties. The impact of the island on the total excess SO4(-) and H(+) concentrations was small relative to off-island sources. There is a strong correlation between the presence of sulfuric and nitric acids and the meteorological back trajectories of Bermuda storm sys-

tems to the North American continent. This suggests the long-range transport of acid-rain precursors to Bermuda from the North American continent. (See also W88-08442) (Vernooy-PTT) W88-08446

HYBRID RECEPTOR MODELS.

Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Sciences Research Lab.
C. W. Lewis, and R. K. Stevens.
IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemistal Society

mospheric Processes. American Chemical Society, Washington, DC. 1987. p 58-65, 3 tab, 10 ref.

Descriptors: *Chemistry of precipitation, *Model studies, *Mathematical models, *Receptor models, *Air pollution, *Acid rain, Data interpretation, Meteorological data collection, Sulfates, Sulfur, Sclenium, Lead, Model testing, Deep Creek Lake

A hybrid receptor model is defined as a specified mathematical procedure which uses not only the ambient species concentration measurements that form the input data for a pure receptor model, but in addition source emission rates or atmospheric dispersion or transformation information characteristic of dispersion models. By utilizing more information, hybrid receptor modeling promises improved source apportionment estimates or, more fundamentally, consideration of problems that are inaccessible in terms of classical receptor modeling. Several examples of hybrid receptor modeling are reviewed, emphasizing the great variety in possible approaches, and in the choice of input versus output quantities. A simple illustration is given of a hybrid receptor model applied to the comprehensive ambient-source-meteorological data base collected at Deep Creek Lake, Maryland during summer 1983. (See also W88-08442) (Author's abstract) during summer thor's abstract) W88-08447

TRACE ELEMENT CONCENTRATIONS ON FINE PARTICLES IN THE OHIO RIVER

Maryland Univ., College Park. Dept. of Chemis-

try. S. G. Tuncel, G. E. Gordon, I. Olmez, J. R.

S. O. Tuncei, C. E. Gordon, I. Oimez, J. R. Parrington, and R. W. Shaw. IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 66-81, 3 fig., 3 tab, 24 ref.

Descriptors: *Air pollution, *Trace elements, *Sulfates, *Particulate matter, *Ohio River Valley, *Air masses, *Path of pollutants, *Chemistry of precipitation, *Field tests, *Acid deposition, X-ray fluorescence, Neutron activation analysis, Receptor models.

Atmospheric particles were collected from May, 1980 to Dec., 1981 at 3 sampling sites in the Ohio River Valley (ORV). The collected samples were analyzed by x-ray fluorescence (XRF) for elemental concentrations and their masses determined by beta gauging. The XRF data and associated wind trajectories were used to select a subset (200) of ORV samples in the fine fraction for further analytics by interpretable seatons activation season. sis by instrumental neutron activation analysis (INAA). Combined XRF and INAA data provided concentration values for up to 40 elements. Chemical mass balances with 11 sources were used to fit trace element concentrations. About 90% of the predicted mass arises from the regional sulfate the predicted mass arises from the regional suitate component, which accounts for most of the observed sulfur. Sulfate concentrations are nearly as high at the west station (in KY) as at the center (IN) and east (OH) stations. This is in disagreement with the usual picture of build-up of sulfate in air masses as they move up the Valley, picking up SO2, which is slowly converted to sulfate. Even SO2, which is slowly converted to sulfate. Even when back trajectories are used to limit consideration to samples of air masses coming from the southwest, the picture remains the same despite the lack of strong sources upwind in MO, AK and OK. We find no reasonable way in which to fit observed sulfate concentrations and S/Se ratios with a simple hybrid receptor model. (See also W88-08442) (Author's abstract) W88-08448

SIMULTANEOUS COLLECTION OF PARTI-CLES AND ACIDIC GASES FOR TRACING EMISSIONS FROM COAL-FIRED POWER PLANTS.

Maryland Univ., College Park. Dept. of Chemis-For primary bibliographic entry see Field 7B. W88-08449

AQUEOUS-PHASE REACTIONS IN CLOUDS, Brookhaven National Lab., Upton, NY. Environ-mental Chemistry Div.

S. E. Schwartz. In: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 93-108, 10 fig, 1 tab, 31

Descriptors: *Chemical reactions, *Acid rain, *Cloud physics, *Kinetics, *Atmospheric water, *Mass transport, *Mathematical models, Chemical properties, Air-water interfaces, Hydrogen ion concentration, Diffusivity, Equilibrium, Solubility.

Reaction of dissolved gases in clouds occurs by the sequence gas-phase diffusion, interfacial mass transport, and concurrent squeous-phase diffusion and reaction. Information required for evaluation of rates of such reactions includes fundamental data such as equilibrium constants, gas solubilities, that such as equinorum constants, gas soutonines, kinetic rate laws, including dependence on pH and catalysts or inhibitors, diffusion coefficients, and mass-accommodation coefficients. Situational data such as pH and concentrations of reagents and other species influencing reaction rates, liquid-water content, drop size distribution, insolation, water content, drop size distribution, insolation, temperature, etc. is also needed. Rate evaluations indicate that aqueous-phase oxidation of S(IV) by H2O2 and O3 can be important for representative conditions. No important aqueous-phase reactions of nitrogen species have been identified. Examination of microscale mass-transport rates indicates that mass transport only rarely limits the rate of in-cloud reaction for representative conditions. Field measurements and studies of reaction kinetics in authentic precipitation samples are consistent with rate evaluations. (See also W88-08442) (Author's abstract) W88-08450

ACCOMMODATION COEFFICIENTS OF OZONE AND SO2: IMPLICATIONS ON SO2 OXIDATION IN CLOUD WATER,

Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.

I. N. Tang, and J. H. Lee. IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 109-117, 4 fig. 1 tab, 11

Descriptors: *Accommodation coefficients, *Ozone, *Sulfar dioxide, *Oxidation, *Chemical reactions, *Cloud physics, *Atmospheric water, *Mass transport, *Acid rain, Kinetics, Air-water interfaces, Ultraviolet radiation, Absorption, Mathematical models.

Interfacial mass transfer of trace gases into aqu phase is investigated in a UV absorption-stop flow apparatus. For the first time, the mass accommodation coefficients are determined for O3 (0.00053) tion coefficients are determined for O3 (0.00053) and for SO2 (>0.02). The results are incorporated into a simple model considering the coupled inter-facial mass transfer and aqueous chemistry in cloud drops. It is shown that dissolution of O3 into a drop is fast compared with its subsequent oxidation of dissolved SO2. In addition, the conversion rate of S(IV) to S(VI) in aqueous drops by ozone reactions is not limited by interfacial resistance. (See also W88-08442) (Author's abstract)

PHOTOCATALYTIC FORMATION OF HY-California Inst. of Tech., Pasadena, W.M. Keck

Group 5B-Sources Of Pollution

Engineering Lab. of Hydraulics and Water Re-

D. W. Bahnemann, M. R. Hoffmann, A. P. Hong,

and C. Kormann.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 120-132, 4 fig, 90 ref.

Descriptors: *Air pollution, *Photoactivation, *Catalysts, *Hydrogen peroxide, *Chemical reactions, *Solar radiation, *Oxidation, *Metals, Zinc, Titanium, Oxides, Sand, Particulate matter.

The two-electron reduction of molecular oxygen to hydrogen peroxide can be catalyzed by metal oxide semiconductor particles in the presence of visible and near-UV light. Even though very high quantum yields for this process are observed, rather low steady-state concentrations of H2O2 are reached. Detailed mechanisms are presented to explain these experimental findings. Metal oxide particles are found in atmospheric and surface waters. The environmental significance of photocatalytic formation of H2O2 on these particles in natural systems is discussed. (See also W88-08442) (Author's abstract)

W88-08452

DIRECT KINETIC AND MECHANISTIC STUDY OF THE OH-DIMETHYL SULFIDE REACTION UNDER ATMOSPHERIC CONDI-TIONS.

Georgia Tech Research Inst., Atlanta.

A. J. Hynes, and P. H. Wine.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 133-141, 2 fig, 2 tab, 23

Descriptors: *Kinetics, *Chemical reactions, *Sulfur cycle, *Sulfur compounds, *Hydroxides, *Dimethyl sulfide, *Atmosphere, *Lasers, *Air pollution, Fluorescence, Nitrogen, Oxygen, Tem-

A pulsed-laser-photolysis to pulsed-laser-inducedfluorescence technique was employed to study the OH + dimethyl sulfide reaction in N2, air, and O2 buffer gases. Complex kinetics were observed in the presence of O2. A four step mechanism involv-ing hydrogen abstraction, reversible addition to the ing hydrogen abstraction, reversible addition to the sulfur atom, and scavenging of the (thermalized) adduct by O2 is required to explain all experimental observations. In one atmosphere of air, the strain bimolecular rate constant decreases montal observations. In one atmosphere of air, the effective bimolecular rate constant decreases monotonically from 1.58 x 10 to the minus 11th power to 5.2 x 10 to the minus 12th power cu cm/molecule/s over the lower tropospheric temperature range 250-310K. Over the same temperature range the branching ratio for hydrogen abstraction increases monotonically from 0.24 to 0.87. (See also W88-0842) (Author's abstract)

SO2 OXIDATION BY HYDROGEN PEROXIDE IN SUSPENDED DROPLETS,

Frankfurt Univ. (Germany, F.R.). Inst. fuer Meteorologie und Geophysik.
W. A. Jaeschke, and G. J. Herrmann.
IN: The Chemistry of Acid Rain: Sources of At-

mospheric Processes. American Chemical Society, Washington, DC. 1987. p 142-157, 9 fig, 1 tab, 7

Descriptors: *Air-water interfaces, *Sulfur dioxide, *Hydrogen peroxide, *Oxidation, *Atmospheric water, *Fluid drops, *Vadose water, *Acid rain, Dynamics, Kinetics, Accommodation coefficient, Sulfur cycle, Simulation.

One of the most significant reactions in the context of acidity in rainwater is the SO2-oxidation by hydrogen peroxide in aqueous solution. Therefore a dynamic flow reactor was constructed, where SO2 removal rates could be investigated in the presence of H2O-containing droplets. The diameter of the suspended droplets was in the size range between 1 micron and 25 microns, which is comparable to size distributions observed in atmospheric clouds or fogs. Pseudo first order rate constants of the SO2-oxidation were measured at different pH-

values. The H2O2-concentration in the droplets was varied between 0.00002 M and 0.01 M. The obtained second order rate constants were strongly pH-dependent (1.48 X 10 to the 5th power L/mol/sec at pH 2 and 130 L/mol/sec at pH 5.5). At H2O2-concentrations above 0.001 M the microphysical transfer of SO2 via droplet interface became the rate determining step. From the experiments an accommodation-coefficient for SO2 could be calculated which was greater than 0.1. (See also W88-08442) (Author's abstract)

MEASUREMENT OF CONCENTRATION AND OXIDATION RATE OF S(IV) IN RAINWATER IN YOKOHAMA, JAPAN,

Keio Univ., Yokohama (Japan). Dept. of Applied Chemistry.

S. Tanaka, K. Yamanaka, and Y. Hashimoto.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 158-169, 4 fig, 4 tab, 9

Descriptors: *Sulfur compounds, *Sulfites, *Oxidation, *Acid rain, *Yokohama Japan, *Kinetics, *Chromatography, Water sampling, Sulfates, Chemical reactions, Iron, Manganese, Catalysts, Sample preparation, Trace metals.

Sulfite and bisulfate in rainwater are rapidly oxidized to sulfate by the catalytic effect of metallic ions such as Fe(III) and Mn(II). The rates of oxidation of S(IV) in test solutions were measured using ion chromatography. The rate constant, k, measured for a 12.5 micromolar S(IV) solution was found to be 0.6-10.4/hr at pH 3-6 in the presence of 1.8 micromolar Fe(III) and 0.18 micromolar Mn(II) catalysts, and 0.45-9 x 10 to the minus 3rd power/hr without the catalysts. Triethanolamine (TEA) was used to stabilize actual rainwater samples prior to analysis. TEA masks the catalytic effect of metallic impurities found in the rainwater. The concentrations and the rates of oxidation of The concentrations and the rates of oxidation of S(IV) in rainwaters from Yokohama, Japan measured by this method were 0.8-23.5 micromolar (16 samples) and 0.12-3.3/hr (8 samples), respectively. (See also W88-08442) (Author's abstract) W88-08455

SPECTROSCOPIC IDENTIFICATION OF PRODUCTS FORMED IN THE GAS-PHASE REACTION OF OH WITH ATMOSPHERIC SULFUR COMPOUNDS,

Atlanta Univ., GA. Dolphus E. Milligan Science Research Inst.

S. C. Bhatia, and J. H. Hall.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 170-182, 3 fig, 3 tab, 30

Descriptors: *Acid rain, *Spectroscopy, *Infrared spectroscopy, *Sulfur cycle, *Sulfur compounds, *Sulfur dioxide, *Chemical reactions, *Chemical analysis, Air pollution.

The matrix-isolation infrared study of the reactions OH + R (R = CH3SH, CH3SSCH3, SO2) indicate that the products observed for CH3SH + OH reaction are the proposed intermediate CH3SHOH and SO2 while CH3SH, CH3SHOH and SO2 are formed in CH3SSCH3 + OH reaction. The reaction of hydroxyl radical with sulfur dioxide yields HOSO2.H2O complex as the final product. The vibrational assignments for the observed products are reported. (See also W88-08442) (Author's abstract) W88-08456

CHARACTERIZATION OF A FACILITY TO SIMULATE IN-CLOUD CHEMICAL TRANS-

Nevada Univ. System, Reno. Energy and Environ-mental Engineering Center. For primary bibliographic entry see Field 7B. W88-08457

COMPARISONS OF WET AND DRY DEPOSITION: THE FIRST YEAR OF TRIAL DRY DEPOSITION MONITORING,

National Oceanic and Atmospheric Administra-tion, Oak Ridge, TN. Atmospheric Turbulence and Diffusion Div

For primary bibliographic entry see Field 7A. W88-08458

RAINWATER CHEMISTRY NEAR AN ISO-LATED SO2 EMISSION SOURCE, Washington Univ., Seattle. Dept. of Civil Engi-

neering.
R. J. Vong, T. V. Larson, W. H. Zoller, D. S. Covert, and R. J. Charlson.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 204-212, 2 fig, 1 tab, 10

Descriptors: *Data interpretation, *Water pollution sources, *Chemical reactions, *Acid rain, *Rain, *Sulfur dioxide, *Industrial plants, *Copper, *Seattle-Tacoma area, *Sulfates, Hydrogen ion concentration, Trace metals, Ions, Mapping, Atomic absorption spectroscopy, Instrumental neutron activation analysis.

A network of 38 rainwater collection sites was A network of 38 rainwater collection sites was established in the Seattle-Tacoma area of Washington State both upwind and downwind of the dominant regional SO2 emission source, a copper smelter. Rainwater samples were chemically analyzed for pH, major ions and trace metals (via instrumental neutron activation analysis). Results are presented for a precipitation event sampled by the network on February 14-15, 1985. Two collectors were operated at each site with these paired results statistically screened for potential contamination based on independently measured experimental unsatisfically screened for potential communication based on independently measured experimental uncertainties. Geographical mapping of rainwater concentrations demonstrated a clear enhancement of H(+), excess SO4(-), and trace metals downwind of the smelter. Principal component analysis revealed the influence of seasalt, crustal material, and a component interpreted to represent smelter. and a component interpreted to represent smelter SO2 and trace metal emissions. (See also W88-08442) (Author's abstract)

SULFUR, HALOGENS, AND HEAVY METALS IN URBAN SUMMER RAINFALL, IN URBAN SUMMER RAINFALL, McMaster Univ., Hamilton (Ontario). S. Landsberger, S. J. Vermette, and J. J. Drake. IN: The Chemistry of Acid Rain: Sources of At-mospheric Processes. American Chemical Society, Washington, DC. 1987. p 213-218, 1 fig. 2 tab, 7

Descriptors: *Sulfur, *Halogens, *Heavy metals, *Rainfall, *Path of pollutants, *Urban hydrology, *Spectroscopy, Inductively-coupled Plasma Mass Spectroscopy, Instrumental neutron activation analysis, Hamilton, Ontario, Acid rain, Copper, Zinc, Chromium.

Two multi-elemental techniques (instrumental neu-tron activation analysis and inductively-coupled tron activation analysis and inductively-coupled plasma mass spectroscopy) were used to determine sulfur, halogens, and 14 other trace elements in urban summer rainfall. Quality control was assured using NBS reference materials. The overall accuracy and precision of these two methods makes possible the routine analysis of many environmentally important trace elements in acid rain related investigations. Enrichment factor calculations showed that several elements including S, Cu, Zn and Cr were abnormally enriched in the urban atmosphere. A comparison of three separate sites showed a strong gradient of metal deposition from the industrial to the outlying areas. (See also W88-08442) (Author's abstract) 08442) (Author's abstract) W88-08460

INTRODUCTION OF FORMATE AND ACE-TATE IONS INTO PRECIPITATION: ASSESS-MENT OF POSSIBLE PATHWAYS, Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 2K.

Sources Of Pollution-Group 5B

W88-08461

COMPARISON OF WEEKLY AND DAILY WET DEPOSITION SAMPLING RESULTS, Environmental Monitoring and Services, Inc., Ca-

Environmental marillo, CA.
L. E. Topol, M. Lev-On, and A. K. Pollack.
IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society,
Washington, DC. 1987. p 229-241, 3 fig. 2 tab, 13

Descriptors: *Water pollution sources, *Precipita-tion sampling, *Rainfall, *Sampling frequency, *Ions, *Seasonal variation, *Acid rain, Comparison studies, Rain gauges, Hydrogen ion concentration, Ammonium, Potassium, Sodium, Chlorides, Mag-

An initial analysis of data from a one-year field study comparing the concentrations of weekly measured samples and weekly values derived from daily samples indicated that the weekly measured ion concentrations were generally larger. Although the mean relative bias values ranged from 0 to 34%, most values were < 10%. In addition, the greatest differences were found in the fall season with biases > 10% occurring for ammonium, chloride, sodium, potassium, calcium and magnesium. Samples were collected at three sites in Georgia, Kansas and Vermont to represent the southeastern. central (west of she Mississium). Kansas and Vermont to represent the southeastern, central (west of the Mississippi River) and north-eastern regions of the United States. The measure-ments included precipitation weight, pH, sulfate, nitrate, chloride, ammonium, potassium, sodium, calcium and magnesium. Other than the two different sampling intervals, all field and laboratory procedures were identical. (See also W88-08442) (Author's abstract) W88-08462

CHEMISTRY OF WINTERTIME WET DEPOSI-

General Motors Research Labs., Warren, MI. Environmental Science Dept. J. M. Dasch.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 242-249, 4 tab, 14 ref.

Descriptors: *Chemical reactions, *Snow sampling, *Chemistry of precipitation, *Acid rain, *Precipitation sampling, *Temperature effects, *Atmospheric water, *Nitrates, *Sulfates, Clouds, Michigan.

Four years of winter precipitation data from south-eastern Michigan were examined to help under-stand the higher NO3(-), but lower SO4(-), con-centrations in snow than in winter rain. The higher NO3(-) levels in snow could be attributed to the NO3(-) levels in snow could be attributed to the lower precipitation depths associated with snow events than with rain events. Conversely, SO4(-) was far higher in winter rain than in snow. The SO4(-) concentrations were highly correlated with the temperatures of the cloud layers. The data suggests that SO2 is incorporated and oxidized to SO4(-) in clouds most efficiently when the hydrometeors are present as liquid droplets. The fact that NO3(-) does not show the same relationship suggests that incorporation of nitrogen species into cloud water followed by oxidation is not as important a process for nitrogen as for sulfur. (See also W88-08442) (Author's abstract)

POLLUTANT DEPOSITION IN RADIATION

California Inst. of Tech., Pasadena. Dept. of Envi-ronmental Engineering Science. J. M. Waldman, D. J. Jacob, J. W. Munger, and M.

R. Hoffmann.
IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 250-257, 3 fig, 1 tab, 6

Descriptors: *Acid rain, *Path of pollutants, *Fog, *Air pollution, *Air-earth interfaces, *Deposition, *Atmospheric water, *San Joaquin Valley, Sul-

fates, Nitrates, Gases, Aerosols, Hydrogen ion con-centration, California.

A study of atmospheric pollutant behavior was conducted in the southern San Joaquin Valley of California during periods of stagnation, both with and without dense fog. Measurements were made of gas-phase and aerosol pollutant concentrations, fogwater composition, and deposition of solutes to surrogate surfaces. Deposition rates for major species were 5 to 20 times greater during fogs compared to nonfoggy periods. Sulfate-ion deposition velocities measured during fog were 0.5 to 2 cm/s. Rates measured for nitrate ion were generally 50% below those for sulfate, except for acidic fog (pH-C3) conditions, because mirate was less effectively scavenged by neutral or alkaline fogs. In (pH < 5) conditions, because mirate was less effectively scavenged by neutral or alkaline fogs. In radiation fogs, scavenging of ambient aerosol was observed to increase as liquid water content rose. The lifetimes for atmospheric sulfate and ammonium were short (6-12 h) during dense fog compared to the ventilation rate (> 3 d) for valley air. (See also W88-08442) (Author's abstract) W88-08464

DEPOSITION OF CHEMICAL COMPONENTS IN JAPAN,
Meteorological Research Inst., Yatabe (Japan).
Y. Dokiya, M. Aoyama, Y. Katsuragi, E.
Yoshimura, and S. Toda.
IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society.

mospheric Processes. American Chemical Society, Washington, DC. 1987. p 258-272, 6 fig. 4 tab, 7

Descriptors: *Water pollution sources, *Rainfall, *Acid rain, *Japan, *Chemical analysis, Regional analysis, Deposition, Nitrates, Calcium, Sulfates, Path of pollutants, Spatial distribution.

In order to determine the chemical characteristics of Japanese rain, the major chemical components were determined at eleven stations throughout Japan for two years. Deposition samples were collected and analyzed monthly. The principal component analysis showed that nitrate and calcium can be used to characterize the local factors. The can be used to characterize the local factors. The deposition of sulfate is discussed in relation to its origin, and the effect of sulfate deposition on the chemistry of soil is examined. The northeastern part of Honshu Island is relatively tolerant to acid deposition because of the relatively rich organic soils. This may be one of the reasons why few typical symptoms of the effects of acid precipitation are seen in this high near the Tokyo area. The western part of Honshu Island is relatively susceptible to acid deposition. (See also W88-08442) (Vernoov-PTT) (Vernooy-PTT) W88-08465

MEASUREMENT OF ATMOSPHERIC GASES BY LASER ABSORPTION SPECTROMETRY, Unisearch Associates, Inc., Concord (Ontario). For primary bibliographic entry see Field 7B. W88-08466

CHEMICAL INSTRUMENTATION OF AT-MOSPHERIC WET DEPOSITION PROCESS-

Brookhaven National Lab., Upton, NY. Dept. of Applied Science

For primary bibliographic entry see Field 7B.

FACTORS AFFECTING NOX PRODUCTION DURING CHAR OXIDATION, Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering. G. J. Orehowsky, A. W. Scaroni, and F. J.

Derbyshire. IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 304-316, 11 fig. 3 tab, 15

Descriptors: *Nitrogen oxides, *Acid rain, *Acridine, *Phenanthridine, *Incineration, Nitrogen, Carbon, Chemical reactions, Air pollution.

Because NO (x) emissions play an important role in acid rain formation, the oxidation of chars prepared from nitrogen-containing precursors was investigated. Chars produced from the nitrogen-containing compounds acridine and phenanthridine were oxidized at atmospheric pressure at temperatures of 773-873 K. The relative rates of nitrogen and anthor planes and the formation of NOx have tures of 773-873 K. The relative rates of nitrogen and carbon release and the formation of NOx have been determined in relation to char nitrogen content and precursor type. At 773 K carbon was found to be preferentially oxidized at low burnoff; at higher temperatures the rates of carbon and nitrogen oxidation were indistinguishable. The conversion of char nitrogen to NOx was dependent upon the char structure and composition, much less NOx being produced from the phenathridine char. It is assumed that the remainder of the nitrogen is released as N2, presumably formed by the reduction of NOx with C and/or CO. The conversion of nitrogen to NOx was also found to decrease with increasing oxidation temperature, char nitrogen content and with sample bed height. (See also W88-08468)

ACID CLUSTERS,

Pennsylvania State Univ., University Park. Dept. of Chemistry. For primary bibliographic entry see Field 2K. W88-08469

REMOTE SENSING INVESTIGATION OF THE OIL SPILL IN THE STRAIT OF MESSINA,

ITALY,
Catania Univ. (Italy). Dept. of Engineering.
A. L. Geraci, G. La Rosa, and L. Del Re.
IN: Europe from Space. Proceedings of an ESA/
EARSeL Symposium held in Conjunction with
EARSeL's General Assembly at the Technical
University of Denmark, Lyngby, June 25-27, 1986.
Report No. SP-258, December 1986. p 109-114, 9
fig. 1 tab. 12 pef fig, 1 tab, 12 ref.

Descriptors: *Remote sensing, *Oil spills, *Path of pollutants, *Strait of Messina, *Italy, Cleanup operations, Economic aspects, Infrared imagery, Satellite technology, Landsat, Costs.

On the morning of March 21, 1985, the Greek tanker Patmos and the Spanish tanker Castillo de Monte Aragon collided in the Strait of Messina. About 1,000 metric tons of oil were spilled from the Patmose, threatening the east Sicilian coastal zone. Boats and aircraft used during the response, encountered problems in locating the slicks. The present investigation was carried out using infrared photography and MSS Landsat data only, to investigate the oil spill. Results indicate that the early detection and monitoring of oil in the marine environment can significantly improve predictions of its location, nature, areal extent, and behavior, over subsequent periods of time. Also, the treatover subsequent periods of time. Also, the treatment required, and a determination of the responsibility for any damage, both depend upon the reliability with which the oil can be monitored under the prevailing weather conditions. If remote tech-niques had been used on a regular basis during the oil spill response, the damages would certainly have been less, at least in terms of cleanup costs. (See also W88-08470) (Lantz-PTT)

CHEMICAL ANALYSIS OF HYDROCARBON CONTENT IN WATER, Norsk Inst. for Vannforskning, Oslo. T. Bakke, and K. Sorensen.

IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, December 1984. p 3-16, 4 fig.

Descriptors: *Path of pollutants, *Oil pollution, *Chemical analysis, *Hydrocarbons, Rock Littoral Project, Fluorescence spectroscopy, Gas chromatography, Oil, Fuel.

The purpose of the hydrocarbon analysis within the hard bottom, Rock Littoral project, was to determine the levels of hydrocarbons in the dosing

Group 5B-Sources Of Pollution

system, the basins and the organisms. The substrate on the walls has also been sampled. Two types of analysis are involved in this project: (1) Fluorescence spectroscopy; and (2) High resolution gas chromatography. The fluorescence analysis of the water accomodated fraction (WAF) produced in the dosing system and the basin waters has shown that the littoral communities during the period September 1982 to September 1984 were exposed to the following mean concentrations of total cili to the following mean concentrations of total oil hydrocarbons: High Oil (HO) basin: 129.4 micrograms/L and Low Oil (LO) basin: 30.1 micrograms/L. Background fluorescence (oil and other grams/L. Background Huorescence (oil and other components) was 5.6 micrograms/L. Gas chroma-tographic analysis of the concentrations of oil in the basins showed the mean values: HO basin: 82.3 micrograms/L and LO basin: 22.7 micrograms/L. The GC-analysis also indicated an enrichment of aromatic hydrocarbons in the basin water relative to the original diesel oil applied (58 and 23% aromatics respectively). Both the fluorescence and GC analysis showed that the surface film of the HO basin had higher concentration (75-100%) of hydrocarbons than the water below. (See also W89.80482) (1.002-PTT) W88-08482) (Lantz-PTT)

CHEMICAL ANALYSIS OF HYDROCARBON CONTENT IN ORGANISMS, Sentralinstitutt for Industriell Forskning, Oslo

Sporstol, and F. Oreld.

s. sporssos, and F. Ofeld. IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, Decem-ber 1984. p 17-28, 6 fig. 1 tab.

Descriptors: *Chemical properties, *Hydrocarbons, *Path of pollutants, *Bioaccumulation, Alanes, Oil pollution, Hydrocarbons, Gas chromatography, Napthalene, Phenanthrene, Anthracene, Dibenzothiophenes, Tissue analysis, Mollusks, Algae.

Four different species of marine organisms have Four different species of marine organisms have been selected for tissue analysis; Fucus serratus, Ascophyllum nodosum, Mytilus edulis, and Littorina littorea. Samples have been collected both from the High Oii (HO), Low Oii (LO) and control basins, and covers the first 14 months of exposure. Ascophyllum nodosum have been collected at 2 different dates, while the other three species have different dates, while the other three species have been collected at 3 different dates. Exposed Mytilus and Littorina generally have the highest contents of both naphthalenes, phenanthrenes/anthracenes and dibenzothiophenes (NPD) and total hydrocarbon content (THC). In terms of trends, a remarkably consistent picture emerges for NPD independent of species or seasonal variations. Highest concentrations are found in organisms from the HO basin and the concentrations measured in the LO basin are in between what is ured in the LO basin are in between what is measured in the HO and control basins. The same general trend, although not so consistent, is also found for THC. Gas chromatograms of Mytilus and Littorina typically contain an unresolved com-plex matter with maximum at n-C sub 20 alkane. The relative amount of n-alkanes versus the unre-solved complex matter is low for these two spe-cies. Chromatograms of exposed Fucus and Asco-phyllum also contain an unresolved complex matter, but substantial amounts of resolved components, including n-alkanes are also found. (See also W88-08482) (Lantz-PTT)

ORGANIC ENRICHMENT OF SUBTIDAL SEDIMENTS WITH POWDERED ASCHO-PHYLLUM NODOSUM: AN EXPERIMENTAL STUDY IN THE SOFT BOTTOM MESOCOSM AT SOLBERGSTRAND,

AT SOLBERGSTRAND,
J. A. Berge, M. Schanning, and K. Sandoy.
IN: Long Term Effects of Oil on Marine Benthic
Communities in Enclosures. Norwegian Institute
for Water Research Report No. 0-82007, December 1984. p 195-228, 5 fig, 8 tab, 4 ref.

Descriptors: *Benthos, *Organic matter, *Subtidal sediments, *Sediment transport, *Water pollution effects, *Path of pollutants, Estuaries, Benthic environment, Ecological effects, Environmental ef-

fects, Sediments, Norway, Pilot studies, Meso-

Subtidal areas of the continental shelf are supplied with organic matter in the form of sedimenting with organic matter in the form of sedimenting particles. These particles may originate from primary or secondary production in the water column, or from benthic and terrestrial primary production transported to the subtidal benthos. The amount of organic material available to subtidal areas is a fundamental factor which sets the ultimate limits for secondary production in the subtidal. Other environmental factors (pollution, anoxia, currents, biological interactions) may prevent secondary production to reach the limit set by the food supply. Transport of contaminants from the surface water masses to the subtidal benthos may be linked to sedimenting particles, showing the importance of this process. In future experiments at Solbergstrand, the faunal and porewater responses to natural and anthropogenic substances ments at Solbergstrand, the faunal and porewater responses to natural and anthropogenic substances arriving at the sediment surface will be studied. In the spring of 1984, 20 experimental boxes with sediment collected by the USNEL box-corer were available for experimentation. Since future experiments to be carried out in the mesocosm will be related to natural and anthropogenic substances incorporated with subtidal sediments, it was decided to start a pilot experiment by doing boxes with organic matter. The intentions of this experiment were: (1) to see how the fauna and porewater in the sediment in the mesocosm behaved in response were: (1) to see how the fauna and porewater in the sediment in the mesocosm behaved in response to organic enrichment; and (2) to gain some quanti-tative information on how much sediment can be brought into the mesocosm before the porewater chemistry is changed sufficiently to affect macro-fauna densities. Experience from these experiments will be used in designing future experiments in the mesocosm. (See also W88-08482) (Lantz-PTT) W88-08495

ENVIRONMENTAL EFFECTS OF ELECTRICITY GENERATION.

Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 4C.
W88-08503

F-AREA SEEPAGE BASINS,

Savannah River Lab., Aiken, SC. Environmental Sciences Div.

P. Corbo, T. H. Killian, N. L. Kolb, and I. W.

Marine.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011220. Price codes: Al0 in paper copy, A01 in microficher. Environmental Information Document. Report No. DPST-85-704, December 1986. 239 p., 40 ref., 92 tab, 53 ref, 2 append. DOE Contract No. DEACO9-768R00001.

Descriptors: *Path of pollutants, *Water pollution control, *Seepage, *Savannah River Powerplant, *Georgia, *Radioactive wastes, Groundwater pollution, Aquifers, Waste disposal, Model studies, Mathematical studies, Environmental effects, Environmental impact statement, Powerplants.

The F-Area Seepage Basins have been in operation at the Savannah River Plant (SRP) since 1955 for The F-Area Seepage Basins have been in operation at the Savannah River Plant (SRP) since 1955 for the handling of liquid wastes containing low-level radioactivity and chemicals from the F-Area separations facilities. The basins are operating under Resource Conservation and Recovery Act (RCRA) interim status, and a Part B application has been filed. There are 17 RCRA and 13 radioactive groundwater monitoring wells located around the three F-Area Seepage Basins. The RCRA wells monitor not only the water table in the vicinity of the basins but also underlying aquifers in an effort to detect any vertical contaminant migration. Soil cores have been taken from the F-Area Seepage Basins over the operating history, Area Seepage Basins over the operating history, and an extensive program to characterize the basins was conducted in 1984. Both radioactive and nonradioactive constituents were found in the and nonradioactive constituents were found in the basin sediments. Three options for the closure of the F-Area Seepage Basins have been evaluated to assess the risks to humans and impacts to environ-mental ecosystems: waste removal and closure, no waste removal and closure, and no action. The

predominant pathways for human exposure to con-taminants are through surface, subsurface, and at-mospheric transport. Modeling calculations were performed to determine the risks to humans via these pathways for the postulated closure options. Modeling calculations were also performed to de-termine ecological impacts. A cost estimate was prepared for each option. The environmental impact evaluation indicates that the relative human health risks for all closure options are low. The health risks for all closure options are low. The reduction in risk for the waste removal and closure option is small compared to the no waste removal option. The waste removal and closure option. The waste removal and closure option is considerably more expensive than the other closure options. (Lantz-PTT) W88-08508

SAVANNAH RIVER PLANT ENVIRONMEN-TAL REPORT: ANNUAL REPORT FOR 1986.

Radiological Assessments Corp., Neeses, Sc. C. C. Zeigler, E. M. Heath, L. B. Taus, J. L. Todd, and J. E. Till.

and J. E. 111.

Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-012392. Price codes: A14 in paper copy, A01 in microfiche. Report No. DPSPU-87-30-1, Volume II: Figures and Data Tables. (1986). 319 p, 43 fig, 112 tab.

Descriptors: *Savannah River Powerplant, *Georgia, *Data collections, *Fate of pollutants, *Water quality, *Radioactive wastes, Path of pollutants, Regulations, Powerplants.

This volume of the Savannah River Plant (SRP) This volume of the Savannah River Plant (SRP) Environmental Report for 1986 contains the fig-ures and tables. The figures contain graphic illus-trations of sample locations and/or data. The tables contain summaries of the following types of data: (1) Federal and State standards and guides applica-ble to SRP operations; (2) Concentrations of radio-strictive in environmental medics (3). The quantitaactivity in environmental media; (3) The quantity of radioactivity released to the environment from SRP operations; (4) Offsite radiation doses from SRP operations; (5) Measurements of physical properties, chemicals and metals (nonradioactive) properties, chemicals and metals (nonradioactive) concentrations in environmental media; and (6) Interlaboratory comparison of analytical results. The figures and tables in this report contain information about the routine environmental monitoring program at SRP unless otherwise indicated. No attempt has been made to include all data from environmental research programs. Variations in content from year to year reflect changes in the routine environmental monitoring program or the inability to obtain samples from a specific location. (Lantz-PTT) W88.08500

DRASTIC: A STANDARDIZED SYSTEM FOR EVALUATING GROUND WATER POLLUTION POTENTIAL USING HYDROGEOLOGIC SET-

National Water Well Association, Worthington, For primary bibliographic entry see Field 7A. W88-08510

PHOTOCHEMISTRY OF ENVIRONMENTAL

Miami Univ., FL.
ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. Edited by R.
G. Zika and W. J. Cooper. Based on a symposium sponsored by the Divisions of Geochemistry and Environmental Chemistry at the 189th Meeting of the American Chemical Society, Miami Beach, Florida, April 28-May 3, 1985. 288 p. Miami Univ., FL.

Descriptors: *Photochemistry, *Photoactivation, *Surface waters, *Sunlight, *Path of pollutants, *Fate of pollutants, *Chemical reactions, *Light penetration, Aquatic environment, Organic compounds, Inorganic compounds, Mathematical models, Oxidation.

When surface waters, which contain either natural or anthropogenic chromophores, are exposed to sunlight, light-initiated chemical reactions often occur. Sunlight-induced photochemical reactions

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in surface waters can broadly be defined as envi-ronmental aquatic photochemistry. Within aquatic photochemistry, it is possible to envision reactions photochemistry, it is possible to envision reactions involving either inorganic and/or organic molecules. A group of papers representing a number of topics provides the reader with an appreciation of the complexity of aquatic photochemistry. The book deals in-depth with several types of photochemical reactions, including direct photoreactions, which involve mostly xenobiotic substances, heterogeneous reactions, including liquid-solid and liquid-liquid interface reactions, and indirect photoreactions, which implicate secondary photo-oxidants. These secondary oxidants come primarily from (1) in situ primary photo-reactions that often produce free radicals, (2) thermal reactions when produce free radicals, (2) the final reactive photo-products such as hydrogen peroxide (H2O2) react with other constituents of the water, and (3) fluxes of atmospheric oxidants through the surface of natural water bodies. Final-Inrough the surrace of natural water bodies. Finally, papers are presented describing mathematical models used for the extrapolation to the natural environment of laboratory-based experiments in environmental photochemistry. (See W88-08527 thru W88-08540) (Friedmann-PTT)

SPECIFIC PHOTOTRANSFORMATION OF XENOBIOTIC COMPOUNDS: CHLOROBENZENES AND HALOPHENOLS,

ZENES AND HALDPHENOUS, Clermont-Ferrand-2 Univ., Aubiere (France). Lab. de Photochmie Moleculaire et Macromoleculaire. P. Boule, C. Guyon, A. Tissot, and J. Lemaire. IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. Ameri-can Chemical Society, Washington, D.C. 1987. p 10-26, 4 fig, 1 tab, 38 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Photocchemistry, *Photoactivation, *Photoprocesses, *Chemical properties, Polarization, Phenols, Chlorinated hydrocarbons, Halogens.

An aspect of aqueous photochemistry related to the fact that water would favor photochemical processes implying polarized or ionic excited states, is emphasized in the class of chlorobenzenes states, is emphasized in the class of chlorobenzenes and halogenophenols. Such photoprocesses would be more specific than homolytic photodissociation leading to radicals. In chlorobenzenes, a photohy-drolyis mechanism was observed. The monochlor-obenzene is quantitatively transformed into phenol groups mechanism was observed. The monochlorobenzene is quantitatively transformed into phenol in aqueous solution, even in acidic media (1 < pH < 13). In polychlorobenzenes, the polarization of the C-Cl bond, which controls the photohydrolysis process, is more affected by substituents in orthoroperson of the polychlorobenzenes, be more affected by substituents in orthoroperson on the position of halogenophenols largely depends on the position of the halogen substitution. The phototransformation of onlagen substitutions (i.e., Cl, Br or I). In 2-halogenophenols, a ring photocontraction accounts for the conversion of 2-chloro and 2-bromo-phenolate into cyclopentadienic carboxyliae acids. The conversion of 2-chloro and 2-bromo-phenolate into cyclopentadiene carboxylate occurs with high quantum yields and excellent specificity. For 3-chlorophenol, a photohydrolysis mechanism accounts for the specific transformation into resorcinol. The primary photoscission that occurs in 4-chlorophenol is essentially homolytic; many photoproducts were observed. (See also W88-08526) (Author's abstract) W88-08527

PHOTOLYSIS OF PHENOL AND CHLORO-PHENOLS IN ESTUARINE WATER, Georgia Univ., Athens. Dept. of Microbiology. H. Hwang, R. E. Hodson, and R. F. Lee. IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. Ameri-can Chemical Society, Washington, D.C. 1987. p 27-43, 3 fig, 4 tab, 27 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Photolysis, *Photoactivation, *Estuaries, *Phenols, Organic substances, Chemical properants, *Photolysis, *Photoactivation, *E *Phenols, Organic substances, Chemical ties, Sunlight, Hydrogen ion concentration.

Phenol and a number of chlorophenols at a concentration of 25 micrograms/L in estuarine water were exposed to sunlight. The relative rates of photolysis decreased in the order 2,4,5-trichloro-

phenol, 2,4-dichlorophenol, pentachlorophenol, p-chlorophenol, and phenol. The photo-transformation rate constants for dichlorophenol, trichlorophenol and pentachlorophenol ranged from 0.3 to 1.2/hr with half-lives ranging from 0.6 to 3 hr (light hours). Phenol and chlorophenol had half-lives ranging from 43 to 118 hr. Similar differences were observed for photo-mineralization with half-lives ranging from 6 to 14 days for dichlorophenol, richlorophenol, and pentachlorophenol and 16 to 334 days for phenol and p-chlorophenol. Changes in pH, season, and cloud cover were among the factors affecting photolysis rates. At a pH below the pK sub a, the photolysis rate was much lower due to a higher rate of photolysis from the phenoxide ion relative to the nonionized form. A decrease in the midday irradiance from 5.4 to 2.6 Einsteins/sq m/hr, due to cloud cover, resulted in photolysis rate constants of trichlorophenol decreasing from 1.07 to 0.30/hr. With the exception of dichlorophenol and pentachlorophenol, the photolysis rate of the compounds was similar in both distilled and estuarine water when the screening factor, i.e., the attenuation of light, of estuarine water was taken into account. (See also W85-08526) (Friedmannattenuation of light, of estuarine water was taken into account. (See also W88-08526) (Friedmann-PTT) W88-08528

SUNLIGHT PHOTOLYSIS OF SELECTED IN-DOLES AND CARBAZOLE IN AQUEOUS COAL-OIL SYSTEMS, Argonne National Lab., IL. Environmental Re-

Argonne National Lab., IL. Environmental Research Div. K. C. Picel, M. S. Simmons, and V. C. Stamoutis. IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p 44-60, 3 fig. 2 tab, 37 ref.

Descriptors: *Fate of pollutants, *Photolysis, *Photoactivation, *Sunlight, *Coal, *Chemical properties, *Indoles, Quantum yields, Distilled water, Aqueous solutions.

Water, Aqueous solutions.

Photolysis rates of indole, 2-methylindole (2-MI), 3-MI, 5-MI, and 7-MI, which ranged from 0.038/hr to 0.18/hr in distilled water, were enhanced 1.3-to 5.0-fold in aqueous CRM-1 (coal-oil research material). Conversely, the rate for carbazole was 2.2-fold lower in aqueous CRM-1 than in distilled water (0.51/hr). Sunlight quantum yields of indoles were high (0.02-1.2), evidence that autocatalysis occurred in distilled water. In aqueous CRM-1, indoles underwent sensitized photolysis, possibly through a superoxide or singlet-oxygen intermediate. The same photoproduct of 3-MI, o-(N-formyl)aminoacetophenone, was found in both distilled water and aqueous CRM-1. Carbazole underwent direct photolysis in both distilled water and aqueous CRM-1. Carbazole underwent direct photolysis in both distilled water and aqueous CRM-1, indicating that it has a different photolysis mechanism from that of indoles in the two systems studied. (See also W88-08526) (Author's abstract) W88-08529

QUANTUM YIELDS OF POLYCHLORODI-BENZO-P-DIOXINS IN WATER-ACETONI-TRILE MIXTURES AND THEIR ENVIRON-MENTAL PHOTOTRANSFORMATION MENTAL

RATES, Manitoba Univ., Winnipeg. Pesticide Research

Lab.
G. G. Choudhry, and G. R. B. Webster.
IN: Photochemistry of Environmental Aquatic
Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p
61-74, 4 fig, 3 tab, 27 ref.

Descriptors: *Dioxins, *Photodegradation, *Fate of pollutants, Photochemistry, *Chemical properties, *Organic compounds, Quantum yields, Isomers, Sunlight, Pollutants, Seasonal variation.

Photochemistry of four individual isomers of polychlorodibenzo-p-dioxins (PCDDs), namely 1,2,3,4,7-pentachlorodibenzo-p-dioxin (1,2,3,4,7-PCDD) (1), 1,2,3,4,7.8-H6CDD (2), 1,2,3,4,6,7.8-H7CDD (3) and 08CDD (4) in water-acctonitrile (2:3 v/v) was investigated using laboratory radiations of wavelength 313 nm. The quantum yields

for the phototransformation of the dioxins 1-4 in these solvent systems were $(9.8 + / - 2.4) \times 0.00001$, $(1.10 + / - 0.02) \times 0.0001$, $(1.53 + / - 0.17) \times 0.00001$ and $(2.26 + / - 0.33) \times 0.00001$, respectively. These quantum yields and the measured absorption spectra together with solar intensity data available in the literature were utilized to estimate the available. the literature were utilized to estimate the sunlight the literature were utilized to estimate the sunlight (environmental) phototransformation first-order rate constants of the PCDD congeners 1-4 in water under conditions of variable sunlight intensity during various seasons; the corresponding half-lives were also determined. In summer, typical half-lives for the phototransformation of the pollutants 1-4 near the surface of water bodies at 40N latitude would be 15 +/- 4, 6.3 +/- 0.1, 47 +/- 5, and 18 +/- 3 days, respectively. (See also W88-08526) (Author's abstract)

PRIMARY PHOTOCHEMICAL PROCESSING IN PHOTOLYSIS MEDIATED BY HUMIC

California Univ., Santa Cruz. Dept. of Chemistry. A. M. Fischer, J. S. Winterle, and T. Mill. IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. Ameri-can Chemical Society, Washington, D.C. 1987. p 141-156, 7 fig, 35 ref.

Descriptors: *Fate of pollutants, *Photochemistry, *Photolysis, *Spectroscopy, Humic acids, Hydrogen ion concentration, Electrical properties, Cations, Lasers.

Natural water samples and humic substance solutions were probed for their phototransient behavior. Laser flash kinetic spectroscopy was used to study two transients common to most samples. One transient with a maximum around 720 mm was quenched by decreasing pH and nitrous oxide. It was present in all waters with DOC and had a spectrum which resembled that of a solvated electron. The signal was linear with leser power. The spectrum which resembled that of a solvated electron. The signal was linear with laser power. The quantum yield for this transient was measured. Samples with higher ground state absorbance yielded a transient with a maximum at 475 mm that was quenched by oxygen. This transient seemed to be a photophysical hybrid with triplet and radical cation character. The results imply a global common energy sink in natural waters that contain dissolved organic matter, with quantifiable energy and electron transfer capabilities. (Friedmann-PTT) W88-08532

LASER FLASH PHOTOLYTIC STUDIES OF A WELL-CHARACTERIZED SOIL HUMIC SUBSTANCE,

STANCE,
Concordia Univ., Loyola Campus, Montreal
(Quebec). Dept. of Chemistry.
J. F. Power, D. K. Sharma, C. H. Langford, R.
Bonneau, and J. Joussot-Dubien.
IN: Photochemistry of Environmental Aquatic
Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p
157-173, 6 fig. 1 tab, 27 ref.

Descriptors: "Humic acids, "Soil chemistry, "Soil water, "Photolysis, "Absorption, "Degradation, "Fate of pollutants, Lasers, Chemical properties, Ouantum mechanics

Laser flash photolysis studies of the well-characterized soil humic substance, Armadale Fulvic Acid (P.E.I., Canada), have been carried out with excitation at 355 nm on picosecond and nanosecond time scales. Three principal transient absorption signals have been observed in aqueous solutions. tion: a component with a maximum absorption at 675 nm and a lifetime of about 1 microsecond (at pH = 7.0), a second component with a maximum absorption at 475 nm and a lifetime of 1-10 microseconds, and a third component with a broad, featureless transient absorption spectrum and a lifetime in excess of 100 microseconds. The 675 nm signal is believed to be a solvated electron on the basis of lifetime and quenching data, and is ob-served 20 ps after excitation. The 475 nm signal is believed to be a radical cation on the basis of its concurrent appearance with the electron at 20 ps.

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The third featureless component emerges nanose-conds after excitation and is believed to corre-spond to the triplet states of the humic material. (See also W88-08526) (Author's abstract)

PHOTOCHEMISTRY IN AQUEOUS SURFACE

LAYERS: 1-NAPHTHOL, Illinois Univ. a: Urbana-Champaign. Inst. for Enviental Studies

R. A. Larson, and S. A. Rounds.
IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p 206-214, 12 ref.

Descriptors: *Fate of pollutants, *Degradation, *Photochemistry, *Photoactivation, *Surface water, Hydrogen ion concentration, *Chemical properties, Sunlight, Photolysis, Organic compounds, Air-water interace, Surfactants.

1-Naphthol was reactive toward direct photolysis in buffered aqueous solutions (at pH 7, half-life in sunlight was about 90 min) and in cyclohexane (half-life about 15 min). The reaction rate in water increased with pH. The mechanisms of the principal photolysis pathways in both solvents did not involve singlet oxygen. In aqueous solution, the major ether-extractable product, lawsone, may have been formed by a radical process involving 1,2-naphthoquinone and superoxide as intermediates. In cyclohexane, most of the photolysis products observed were very polar. Several oxygen -containing compounds derived from the solvent were also observed. In a two-phase system including cyclohexane and pH 7 buffer, the photolysis appeared to proceed by independent mechanisms in both phases, but intermediate polar products formed in the organic layer diffused into the onesuous layer. In a system containing a surfacenisms in both phases, but intermediate polar prod-ucts formed in the organic layer diffused into the aqueous layer. In a system containing a surface-active material, SDS, the rate of photolysis de-creased; the photoproducts were typical of those observed in cyclohexane rather than water. (See also W88-08526) (Author's abstract) W88-08535

ALGAL-INDUCED DECAY AND FORMATION OF HYDROGEN PEROXIDE IN WATER: ITS POSSIBLE ROLE IN OXIDATION OF ANI-LINES BY ALGAE,

onmental Protection Agency, Athens, GA. east Environmental Research Lab.

Soutneast Environmental Research Lab.
R. G. Zepp, Y. I. Skurlatov, and J. T. Pierce.
IN: Photochemistry of Environmental Aquatic
Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p
215-224, 6 fig. 3 tab, 16 ref.

Descriptors: *Fate of pollutants, *Algae, *Chemical degradation, *Decomposition, Photochemistry, *Water chemistry, Hydrogen peroxide, Biomass, Sunlink, Oridation

The rates of decomposition and photoproduction of hydrogen peroxide (H2O2) by several green and blue-green algae in water were studied. Results suggest that algae have an important influence on the environmental concentration of H2O2, a widely distributed oxidant in natural waters. The algal-catalyzed decomposition of H2O2 in the dark was second-order overall, first order with respect was second-order overlan, instruction with respect to H202, and first-order with respect to algal biomass. Exposure of algal suspensions to sunlight resulted in a buildup of H202, indicating that algae can photoproduce as well as decompose this oxidant. Kinetic results for the algal-induced photopy didation of substituted and algal-induced photopy. idation of substituted anilines are presented and a mechanism involving the intermediacy of H2O2 is discussed. (See also W88-08526) (Author's abstract) W88-08536

MEASUREMENT OF QUANTUM YIELDS IN POLYCHROMATIC LIGHT: DINITROANI-LINE HERBICIDES,

Minnesota Univ., Minneapolis. School of Public

W. M. Draper. IN: Photochemistry of Environmental Aquatic

Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987: p 268-280, 5 fig, 2 tab, 14 ref.

Descriptors: *Photometry, *Chemical properties, *Fate of pollutants, *Model studies, *Mathematical models, Radiation, Wavelength, Computers, Herbicides.

Procedures are described for determination of wavelength-averaged quantum yields in near UV (light (310-410 nm) to be used as input to models for predicting aquatic environmental photolysis rates. A computer program in BASIC language was developed that allows rapid and accurate computations of a disappressance quantum yield (phi). The veloped that allows rapid and accurate computa-tion of a disappearance quantum yield (phi). The widely available Rayonet photoreactor fitted with fluorescent black light lamps was used to measure phi for fluchloralin, isopropalin, and profluralin, important dinitroaniline herbicides. Study of these pesticides demonstrated the utility of the proce-dure as well as the sensitivity of phi to slight changes in molecular structure. (Friedmann-PTT) W88-08540

PREDICTION OF VERTICAL TRANSPORT OF LOW-LEVEL RADIOACTIVE MIDDLESEX SOIL AT A DEEP-OCEAN DISPOSAL SITE, Environmental Research Lab., Narragansett, RI. J. S. Bonner, C. D. Hunt, J. F. Paul, and V. J.

Blerman. Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-227559. Price codes: A04 in paper copy, A01 in microfiche. EPA Report No. EPA 520/1-85-016, September 1986. 60 p, 14 fig, 4 tab, 11 ref, 2 append.

Descriptors: *Path of pollutants, *Ocean dumping, *Radioisotopes, Soil particles, Radium radioisotopes, Uranium radioisotopes, Thorium radioisotopes, Model studies, Soil contamination.

Potential ocean disposal of low-level natural ra-Potential ocean disposal of low-level natural ra-dioisotopes associated with soils was investigated by combining experimental and modeling ap-proaches to determine transport and fate of the material. The experimental approach involved characterization of the source material for particle size distribution resolids gravity, total redisinguistics. characterization of the source material for particle size distribution, specific gravity, total radioisotope activity and distribution, nuclide soluble phase equilibria of the radioisotopes, and particle settling velocities. Soil particles were primarily sandy with a size range from < 63 microns to > 2000 microns and a specific gravity of 2.31. The individual radioisotopes 226-Ra, 234-U, 238-U, and 230-Th exhibited similar distributions (median size of 250 microns), while the distributions for 210-Pb and 210-Po were shifted to the larger particles sizes. Radioisotopes were primarily associated with discrete soil particles. Less than 10% of the associated addioisotopes leached from the soil after exposure crete soil particles. Less than 10% of the associated radioisotopes leached from the soil after exposure to seawater for up to 20 hours. Particle settling velocities measured for a number of size classes in a 1 m settling column ranged up to 8.2 cm/sec (median 2.1 cm/sec). The experimental results were used to calibrate a one-dimensional convective-diffusive particle transport model which was applied to a hypothetical ocean disposal site in 4000 m of water. The model predicted that 95% of the soils and associated radioisotopes would impact the bottom sediments within 4.5 days. Addition of a horizontal transport component to the model the bottom sediments within 4.3 days. Addition of a horizontal transport component to the model indicated that 95% of the soil mass would impact the bottom sediments within 40 km of the disposal point along the direction of mean flow, for typical currents observed off the northeast U.S. continental shelf. (Lantz-PTT) W88-08542

DETERMINATION OF ORGANOPHOS-PHORUS PESTICIDES IN APPLES AND WATER BY GAS-LIQUID CHROMATOGRA-PHY WITH ELECTRON-CAPTURE DETEC-

Higher Inst. of Food Industry, Plovdiv (Bulgaria). For primary bibliographic entry see Field 5A. W88-08555

PRESENCE AND POPULATION DYNAMICS OF ERWINIA CAROTOVORA IN IRRIGATION WATER IN SOUTH CENTRAL COLORADO,

Colorado State Univ., Fort Collins. Dept. of Plant Pathology and Weed Science.

D. A. Maddox, and M. D. Harrison. Journal of Applied Bacteriology JABAA4, Vol. 64, No. 2, p 169-182. February 1988. 1 fig., 4 tab.,

Descriptors: "Water pollution sources, "Path of pollutants, "Irrigation water, "Pollutant identification, "Groundwater pollution, "Bacterial analysis, "Erwinia carotovora, Plant diseases, Rio Grande, Saguache Creek, Rivers, Bacterial populations, Bacteria, Water pollution, Groundwater, Surface water, Well water.

The presence of Erwinia carotovora, casual agents of potato blackle and tuber soft rot, in surface and underground (well) water was studied using filter concentration and anaerobic enrichment techconcentration and anaerooic enrichment techniques. The organism was found in water samples collected at sites in mountainous (over 80 km from potato-producing regions), transitional (upland) and arable regions every month in 1982 and 1983. Filter concentration and anaerobic enrichment of 3-10 L of water yielded E. carotovora from 82.8% of the water samples collected from each 3-10 L of water yielded E. carotovora from 82.8% of the water samples collected from canals, streams, and lakes. The organism was detected direct enrichment of 50 ml water samples in 56.3% of surface water samples collected. E. carotovora subsp. carotovora was the predominant subspecies isolated. Of 1029 strains, 999 (97.1%) were identified as E. carotovora subsp. carotovora and 30 (2.9%) as E. carotovora subsp. carotovora and 30 in water samples collected in arable regions during spring months. Erwinia chrysanthemi was never isolated. Quantitative bacteriological methods were used in 1982 and 1983 to monitor populations. spring months. Erwinia chrysanthemi was never isolated. Quantitative bacteriological methods were used in 1982 and 1983 to monitor populations of E. carotovora in two streams in south central Colorado. These ranged from undetectable levels to 8.5 cfu per ml of water in Rio Grande River and Saguache Creek. Maximum populations were usually reached by August or September in both streams in both years. E. carotovora was isolated from well water samples collected in San Luis streams in both years. E. carotovora was isolated from well water samples collected in San Luis Valley but only 15.6% and 15.4% of the samples jeiled the organism during 1982 and 1983, respectively. E. carotovora subsp. atroseptica was found only once, and E. carotovora subsp. carotovora was the predominant subspecies detected. Filter concentration of 3.4-10.0 L of water plus anaerobic enrichment of the samples was usually necessary to detect E. carotovora in well water. (Author's abstract) W88-08558

ACID RAIN: CHEMISTRY AND TRANSPORT, Warren Spring Lab., Stevenage (England). J. G. Irwin, and M. L. Williams.

Environmental Pollution EPEBD7, Vol. 50, No. 1 and 2, p 29-59. 1988. 14 fig, 3 tab, 86 ref.

Descriptors: *Acid rain, *Path of pollutants, *Chemistry of precipitation, *Sulfur oxides, *Nitrogen oxides, Model studies, Deposition, Europe, Time series analysis, History, Pollutant identification. Pollutants.

This review describes the more important features of the emission, chemistry, transport, and deposition of pollutants involved in acid deposition. Global emissions, both natural and man-made, of sulfur and nitrogen oxides are discussed and examples of spatial distributions and trends over the last century presented, with emphasis on Europe. The more significant chemical and physical processes involved in the transformation of the primary emissions into their acidic end products are described, including a summary of the approximate timescales of the processes involved. Measurements and modelled calculations of spatial and temporal patterns in the deposition of acidic pollutants by both wet and dry pathways are presented. (Author's abstract) stract) W88-08561

TOXIC SUBSTANCES IN RIVERS AND STREAMS,

Nature Conservancy Council, Peterborough (Eng-

For primary bibliographic entry see Field 5C. W88-08562

SILENT EPIDEMIC OF ENVIRONMENTAL METAL POISONING, National Water Research Inst., Burlington (Ontar-

For primary bibliographic entry see Field 5C. W88-08563

GEOSTATISTICS APPLIED TO GROUNDWAT-ER CONTAMINATION, I: METHODOLOGY, South Florida Water Management District, West Palm Beach. Dept. of Resource Management. For primary bibliographic entry see Field 5A. W88-08569

GEOSTATISTICS APPLIED TO GROUNDWAT-ER CONTAMINATION, II: APPLICATION, South Florida Water Management District, West Palm Beach. Dept. of Resource Management. For primary bibliographic entry see Field 5A. W88-08570

POLYCHLORINATED DIOXIN AND FURAN DISCHARGE DURING CARBON REACTIVA-TION,

Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab. B. W. Lykins, R. M. Clark, and D. H. Cleverly. Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p, April 1988. 3 fig, 13 tab, 34 ref.

Descriptors: *Dioxins, carbon, *Polychlorinated dibenzofurans, *Polychlorinated dibenzofurans, *Granular activated exposure, Polychlorinated dibenzofurans, *Granular activated exposure, Public health, Cancer.

Analyses were performed on samples collected from various effluent streams of a fluidized-bed from various effluent streams of a fluidized-bed and infrared furnace during reactivation of granular activated carbon used in treatment of drinking water. Polychlorinated dibenzodioxins and polychlorinated dibenzofurans were produced during granular activated carbon reactivation. No detectable concentrations of polychlorinated dibenzofioxins or polychlorinated dibenzofurans were seen in the spent carbon fed to the reactivation furnaces. Although the total amount of organic halogens on the spent granular activated carbon ranged from 416-657 mg/kg, only small fractional amounts of polychlorinated dibenzofurans and polychlorinated debenzofurans were formed. The low levels of polychlorinated dibenzofurans is and polychlorinated dibenzofurans emitted into the atmosphere ed dibenzofurans emitted into the atmosphere during granular activated carbon reactivation and the resulting cancer risks to the exposed population were minimal and negligible. (Author's abstract) W88-08571

ASSESSMENT OF PHOSPHORUS SOURCES TO BLACK LAKE, NEW YORK, Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering. A. G. Collins, and T. C. Young. Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 337-351, April 1988. 4 fig. 3 tab, 23 ref.

Descriptors: *Sediment transport, *Lakes, *Phosphorus, *Black Lake, *Eutrophic lakes, *Eutrophication, *Suspended sediments, *Water pollution sources, Water pollution, Pollutants, Fluvial sediments, Algal growth, New York, Path of pollutants, Internal phosphorus loading.

Studies are undertaken to assess the nature and studies are undertaken to assess the nature and extent of phosphorus sources affecting eutrophic Black Lake, located in northern New York state. The analysis requires both field and laboratory activities. The results indicate that the shallow, well-mixed body of water has a greater than average potential for resuspension of bottom sediments and associated internal phosphorus levels in the lake often exceed those of fluvial sources, indicating the significance of direct

diffuse loading, including sediment phosphorus re-lease. Experimental batch studies show that resulease. Experimental batch studies show that resu-spension of sediments in aerobic systems result in phosphorus anaerobic incubation. The extent of phosphorus release from internal sources exceeds the inputs from all other sources over relatively short periods during the growing season. (Author's abstract) W88-08573

EFFECTS OF STORM AND GAGE LOCATION ON TRIBUTARY LOAD ESTIMATE, Ohio State Univ., Columbus. Dept. of Civil Engi-

For primary bibliographic entry see Field 7A. W88-08574

LAGRANGIAN TRANSPORT MODELING WITH QUAL II KINETICS. Geological Survey, Tampa, FL. D. H. Schoellhamer. Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 368-381, April 1988. 8 fig, 26 ref.

Descriptors: *Convection, *Nonpoint pollution sources, *Solute transport, *Path of pollutants, *Water quality, *Chattahoochee River, *Loading effects, *Flow, *Unsteady flow, *Mathematical models, *Model studies, Lagrangian transport model, Dissolved oxygen, River flow, Rivers, Ki-

A one dimensional Lagrangian transport model that alleviates the numerical difficulties associated with the use of an Eulerian reference frame by with the use of an Eulerian reference frame by simulating convection with a parcel-tracking algorithm is presented. The Lagrangian transport model (LTM) also simulates dispersion and tributary (or point) and non-point inflows and withdrawals. Convection and dispersion of dye in a laboratory flume with unsteady flow is accurately simulated by the LTM. Up to 10 water quality constituents can be simulated with reaction kinetics defined by the user in a decay-coefficient subroutine. The reaction kinetics of QUAL II, a popular, steady-state. Eulerian, water quality model, are steady-state, Eulerian, water quality model, are inserted into this subroutine. The LTM reproduces QUAL II results and shows durnal and unsteady loading effects in the Chattahoochee River. (Author's abstract) W88-08575

TEMPORAL AND SPATIAL PATTERNS OF NITRATE LOSSES FROM AN AGRICULTURAL CATCHIMENT, Oxford Univ. (England). Geography School. T. P. Burt, and B. P. Arkell. Soil Use and Management, Vol. 3, No. 4, p 138-142, December 1987. 3 fig, 3 tab, 18 ref. NERC Grant GR3/4865.

Descriptors: *Leaching, *Nitrates, *Agricultural runoff, *Temporal distribution, *Spatial distribution, *Path of pollutants, Leachates, Seasonal variation, Surface runoff, Storms, Runoff, Rainfall, England, Land use, Topography, Nonpoint pollution sources, Water pollution sources.

Nitrate losses from a small catchment of mixed land use in south Devon, England, are described.

The temporal pattern of leaching is dominated by major losses through the winter months when both streamflow and nitrate concentration are large. Storm runoff is generated mainly by subsurface stormflow, and nitrate losses are particularly important at such times. The spatial pattern of nitrate loss from the catchment is controlled both by land use and by topography. (Author's abstract) W88-08600

NITROGEN INPUTS AND OUTPUTS IN A SMALL AGRICULTURAL CATCHMENT IN THE EASTERN PART OF THE UNITED KING-

DOM, Institute of Hydrology, Wallingford (England).

G. Roberts. Soil Use and Management, Vol. 3, No. 4, p 148-154, December 1987. 3 fig, 2 tab, 27 ref.

Sources Of Pollution-Group 58

Descriptors: "Nitrogen, "Agricultural runoff, "Ni-trates, "Surface runoff, "Seasonal variation, "Path of pollutants, Streams, England, Catchment areas, Pollution load, Cycling nutrients, Agriculture, Rainfall, Runoff, Nonpoint pollution sources, Water pollution sources.

Nitrate concentrations measured in an ephemeral stream draining a 170 ha clay catchment in eastern England, with about 23% arable land, were greater England, with about 23% arable land, were greater than 11.3 mg N/L on the resumption of flow each autumn but then declined. There was also a spring peak in two years out of seven, 1978-1984, which depend on the length of time soils was at field capacity in the preceding winter. Mean annual load measured in rain was 19 kg N/ha and loss of toad measured in rain was 19 kg N/ha and loss of intrate in the stream 34 kg N/ha. A catchment nitrogen balance suggested that inputs, which averaged 130 kg N/ha/yr, were generally more than outputs, average 108 kg N/ha/yr, but gaseous losses were not taken into account. (Author's abstract) W88-08601

ROUTINE DETERMINATION OF PRINCIPAL GAMMA EMITTING RADIONUCLIDES IN MUDS AND SILTS FROM THE RIBBLE ESTU-

British Nuclear Fuels Ltd., Preston (England). Springfield Works.

For primary bibliographic entry see Field 5A. W88-08606

DETERMINATION OF TECHNETIUM-99 IN THE BROWN MARINE ALGA FUCUS SPIRA-LIS COLLECTED ALONG THE BELGIAN

Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

For primary bibliographic entry see Field 5A. W88-08607

METHODOLOGICAL APPROACH TO THE EVALUATION OF DIFFUSION COEFFICIENTS OF RADIONUCLIDES IN MARINE COASTAL SEDIMENTS,

Pavia Univ. (Italy). Dipt. di Chimica Generale. For primary bibliographic entry see Field 5A. W88-08608

RADIONUCLIDE LEVELS IN RIVER SEDI-MENT NEAR TO A TREATED EFFLUENT OUTFALL,

Ministry of Defence, Aldermaston (England). Atomic Weapons Research Establishment. R. G. C. Gallop, W. N. Lawrenson, J. G. Lockyer, and B. B. Warren.

Science of the Total Environment STENDL, Vol. 70, p 237-251, March 1988. 1 fig, 2 tab, 2 ref.

Descriptors: *River sediments, *Path of pollutants, *Water pollution sources, *Nuclear powerplants, Ecological effects, Radionuclides, Radioactivity, Effluents, Outfall, Thames River, England, Moni-

Analysis of river sediment near to a long estab-lished outfall of a treated radioactive effluent from a nuclear establishment into the River Thames has indicated enhanced, but very low and negligible levels of certain radioactive materials. The highest levels over a small area of the riverbed at its center stream and very close to the outfall; levels of radioactivity only a few meters downstream were considerably lower; the levels of one radionuclide found up to 100 meters downstream were above those found upstream of the outfall. These higher those found upstream of the outfail. I nese inginer levels were only very small fractions of the appropriate Generalized Derived Limits for the particular radionuclides; they posed no danger to the health and safety of the general public, and constitutes no environmental dangers. (Author's ab-

Group 5B—Sources Of Pollution

SEASONAL CHANGES OF UROGLENA AMERICANA IN LAKES CHUZENJI-KO AND YUNO-KO, (IN JAPANESE), Tochigi Prefectural Research Inst. for Environ-mental Pollution, Utsunomiya (Japan). For primary bibliographic entry see Field 2H. W88-08635

EFFECTS OF HEAVY METALS ON THE FRESHWATER SNAIL, SEMISULCOSPIRA BENSONI, IN A CLOSED MINING AREA, (IN JAPANESE), Nagasaki Prefecture Inst. of Health Science and

Environmental Science (Japan).
For primary bibliographic entry see Field 5C.
W88-08636

SEASONAL CHANGES OF ORGANOPHOS-PHOROUS AND ORGANONITROGENOUS COMPOUNDS HYDROLASE ACTIVITIES IN

IIDABORI POND, Science Univ. of Tokyo (Japan). Faculty of Phar-

maceutical Sciences.

M. Tabata, M. Ikegami, K. Kubota, and S. Suzuki.
Japanese Journal of Limnology RIZAA, Vol. 48,
No. 3, p 195-201, July 1987. 4 fig, 1 tab, 19 ref.

Descriptors: *Lakes, *Eutrophication, *Seasonal L'escriptors: "Lakes, "Eutrophication, "Seasonal variation, "Phosphorus compounds, "lidabori Pond Japan, "Enzymes, Hydrolysis, Phytoplankton, Nitrogen compounds, Metabolism, Organic compounds, Biotransformation, Algal growth.

The activities of alkaline phosphatase, urease and protease were determined over a year in order to examine metabolic properties of microorganisms for nitrogenous and phosphorous nutrients in lidabori Pond, a hypertrophic water body. Alkaline phosphatase activity in unfiltered sample water increased in late May when algal bloom appeared for the first time, and during the summer. The activity of the filtrate through a 0.45 micron membrane filter was 3% that of the unfiltered water in brane filter was 3% that of the unfiltered water in summer. Two fractions with alkaline phosphatase summer. I wo tractions with alkaline phosphatase activity were found on gel chromatography of phytoplankton extracts from Iidabori Pond. The approximate molecular weights were 400,000 and 160,000, respectively, and the latter was also found in the filtrate of the pond water. Urease activity was detected from early summer to autumn in the was detected from early summer to autumn in the unfiltered water, but not in the filtrate. The prote-ase activity in the unfiltered water reached maximum in summer and decreased from autumn to winter, but was not observed in the filtrate. Judging from the dependence of the three enzyme activities on pH and water temperature, the pond water maintained the required condition for these hydrolase activities from early summer to autumn. (Author's abstract) W88-08642

DISTRIBUTION OF LACTATE, PROPIO-NATE-, AND ACETATE-OXIDIZING SUL-FATE-REDUCING BACTERIA IN VARIOUS AQUATIC ENVIRONMENTS, Tokyo Metropolitan Univ. (Japan). Dept. of Biol-

M. Fukui, and S. Takii.

Japanese Journal of Limnology RIZAA, Vol. 48, No. 4, p 249-256, December 1987. 3 fig, 3 tab, 37

Descriptors: *Bacterial, *Sulfur bacteria, *Lake sediments, *Marine sediments, Trophic level, Salinity, Sulfates, Fatty acids, Fate of pollutants, Chemical reduction, Spatial distribution, Distribu-

Distribution of sulfate-reducing bacteria (SRB) utilizing lactate (I-SRB), propionate (p-SRB) and acetate (a-SRB) was examined along with some physico-chemical environmental factors such as pH, redox potential and chloride and sulfate levels. Surveys were carried out in five lakes, one river and one marine canal, and involved various trophic levels and salinities. In marine environments, a-SRB showed a tendency to dominate SRB, except for several samples. However, in freshwater environments, I-SRB tended to dominate SRB. In hypertrophic freshwater sediments a-SRR were

found abundantly as well as I-SRB. The relationship between distribution of I-, p- or a-SRB and environmental factors may be controlled by both the quality and quantity of available substrates produced by fermentation as well as studies on the concentrations and turnover rates of available substrates for each SRB and the possible interactions between SRB and other anaerobic bacteria are required. (Vernooy-PTT) w88-8868.

MODEL ANALYSIS OF THE TRANSPORT OF SOLUTES IN SATURATED AND UNSATURATED DOMAINS, (IN JAPANESE), Ehime Univ., Matsuyama (Japan). Dept. of Ocean

Engineering. T. Kakinuma, K. Inouchi, and M. Sawa. Japanese Journal of Limnology RIZAA, Vol. 48, No. 4, p 275-285, December 1987. 10 fig, 17 ref.

Descriptors: *Saline water intrusion, *Groundwater pollution, *Path of pollutants, *Mathematical models, *Solute transport, Saturation, Finite element method, Contamination, Fertilizers, Numerical analysis, Aquifers, Mixing.

The problem of contaminant transport in the saturated and unsaturated domains of phreatic aquifer was investigated. Numerical solutions by the finite-element method are obtained for fertilizer dissolution and seawater intrusion. In fertilizer dissolution from the center of the aquifer surface, since the dispersion coefficient becomes smaller, the pattern of the steady state concentration distribution becomes more eccentric towards the outlet of the aquifer. When the dispersion coefficient increases or the precipitation intensity decreases, the concentration distribution changes more slowly to the steady state distribution. With seawater intrusion, since the dispersion coefficient becomes smaller, the pattern of the steady state concentration distribution in the saturated domain changes from strong to moderate mixing and a circulating cur-rent develops near the outlet of the aquifer. (Au-thor's abstract) W88-08651

EFFECTS OF ORGANIC MATERIALS IN WATER ON THE DESORPTION OF COPPER FROM BOTTOM MUDS AS INFERRED FROM COPPER(II) COMPLEXING CAPACITY, (IN JAPANESE).

ma Inst. of Public Health (Japan).

Oulnia inst. or cont. Table Vision (Span), M. Uchiyama, and H. Akaiwa. Japanese Journal of Limnology RIZAA, Vol. 48, No. 4, p 307-310, December 1987. 2 fig, 1 tab, 13

Descriptors: *Copper, *Metal complexes, *Organic matter, *Dissolved solids, *Description, *Bottom sediments, *Muds, Extraction, Chemical proper-

There are numerous organic materials in natural water which might play an important role in de sorbing metals from bottom muds. However, only a few materials, such as humic acid, EDTA and nitrilotriacetic acid have so far been studied. Some indices of organic materials which can remove indices of organic materials which can remove metals from bottom muds are needed. Copper (II) complexing capacity (CuCC) measured by the back extraction method was proposed as an index for evaluating the effect of organic materials on the desorption of metals from bottom muds. Muds from the Tama and Watarase Rivers were studied. (Author's abstract) W88-08653

HYDROLOGIC CONTROL OF ALUMINUM CHEMISTRY IN AN ACIDIC HEADWATER Maine Univ. at Orono. Dept. of Plant and Soil

Sciences.
G. B. Lawrence, C. T. Driscoll, and R. D. Fuller.
Water Resources Research WRERAO, Vol. 24,
No. 5, p 659-669, May 1988. 12 fig, 3 tab, 48 ref.
National Science Foundation (BSR-8406634), Contribution of the Hubbard Brook Ecosystem Study.

Descriptors: *Path of pollutants, *Water pollution sources, *Acid rain, *Aluminum, *Acid streams,

Chemical properties, Hydrologic properties, Streamflow, Headwaters, Organic carbon, Acidity, Low flow, High flow, Watersheds, Spatial distri-

The influence of hydrologic processes on Al chemistry was investigated along an elevational gradient in a headwater stream at the Hubbard Brook Experimental Forest. Relationships between streamflow and concentrations of inorganic and organic. 110w and concentrations of inorganic and organic Al, H(+), and dissolved organic carbon varied within the watershed. At high elevations, increased streamflow was associated with reduced surface water acidity and decreased inorganic Al concen-trations. At low elevations, however, increased streamflow was associated with increases in stream acidity and concentrations of inorganic Al. Changes in soil flow paths and variations in source Changes in soil flow paths and variations in source areas both appear to regulate stream chemistry. Flow through upper soil horizons under high-flow conditions appears to be the controlling hydrologic influence on stream chemistry at the high-elevation site. At the low-elevation site, contributions of flow from the more acidic, upper region of the watershed during high-flow conditions appears to be the major hydrologic influence on stream chemistry. During low-flow conditions the upper reaches of the stream become dry, so that there is no contribution to flow from this part of the waterreaches of the stream become dry, so that there is no contribution to flow from this part of the water-shed. Stream solutions appeared to be closest to equilibrium with respect to natural gibbsite under high- and low-flow conditions, with no indication that changes in flow introduced disequilibrium conditions. Efforts to incorporate hydrologic effects into surface water acidification models must address the relationship between runoff generation mechanisms and spatial variations in watershed biogeochemistry. (Author's abstract) W88-08659

NEW ANALYTIC FUNCTION FOR MODEL-ING PARTIALLY PENETRATING WELLS, Indiana Univ., Bloomington. School of Public and Environmental Affairs. For primary bibliographic entry see Field 2F. W88-08661

BIOAVAILABILITY OF SEDIMENT-SORBED CHLOROBENZENES TO LARVAE OF THE MIDGE, CHIRONOMUS DECORUS,

Lawrence Livermore National Lab., CA. Environal Sciences Div.

J. P. Knezovich, and F. L. Harrison. Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 226-241, April 1988. 5 fig, 7 tab, 37 ref. U.S. EPA Grant No. DPA-79D-X0856.

Descriptors: *Path of pollutants, *Midges, *Aquatic insects, *Chlorinated hydrocarbons, *Chlorobenzenes, *Benthic fauna, *Bioaccumulation, Accumulation, Insects, Larval growth stage, Sediments, Aquatic habitats, Habitats, Ecosystems.

Larval stages of the midge, Chironomus decorus, Larvai stages of the midge, Chironomus decorus, were exposed to sediment-sorbed, radiolabeled mono, di-, tri-, and hexachlorobenzene to determine the bioaccumulation of these organic compounds. The sediments were either high- or low-organic-content. In addition, equilibrium or none-quilibrium aqueous solutions of the test chemicals flowed through sealed chambers in the sedimentwater exposure system. Uptake of the chloroben-zenes was rapid for all compounds tested, with steady-state conditions being reached within 48 hours. Bioconcentration factors for the accumulation of chlorobenzenes from sediments and from tion of chiorobenzenes in the seament and interstitial and overlying waters were related to the octanol/water partition coefficients of the compounds (ranging from 2.8 for chlorobenzene to 5.5 for hexachlorobenzene). Bioaccumulation fac-5.5 for nexachiorobenzene). Bioaccumulation factors were similar in high-organic-content sediment for equilibrated and nonequilibrated conditions, but more managed to the property of the ganic-content sediment as the source of exposure were significantly higher than those calculated for the experiment with high-organic-content sedi-ment. It was concluded that interstitial water is an accurate indicator of chemical exposure regardless

Sources Of Pollution—Group 5B

of sediment type or exposure conditions. The results show how benthic organisms may be able to accumulate significant levels of chlorinated aromatic compounds from ecosystems in which their concentrations in the water column are relatively low. (Cassar-PTT)

SELECTED METAL LEVELS OF COMMERCIALLY VALUABLE SEAWEEDS ADJACENT TO AND DISTANT FROM POINT SOURCES OF CONTAMINATION IN NOVA SCOTIA AND NEW BRUNSWICK,

Department of Fisheries and Oceans, Halifax (Nova Scotia), Halifax Fisheries Research Lab. G. J. Sharp, H. S. Samant, and O. C. Vaidya. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 724-730, May 1988. 1 fig. 3 tab, 16 ref.

Descriptors: *Path of pollutants, *Algae, *Heavy metals, Metals, Cadmium, Chromium, Copper, Iron, Lead, Zinc, Nickel, Marine plants, Kelp, Irish moss, Nova Scotia, New Brunswick, Aquatic plants, Marine sediments, Sediments.

plants, Marine sediments, Sediments.

Algae commonly harvested on a commercial scale were sampled for heavy metals content. Four sampling points were chosen: (1) Lobster Bay, Nova Scotia, without known heavy metal contamination, (2) Sydney, Harbor, Nova Scotia, and waste sites, (3) Chedabucto Bay, Nova Scotia, in a former refinery area, and (4) Belledune harbor, New Brunswick, near a lead smelter. Belledune Harbor sediment had the highest levels of heavy metals, in general; Chedabucto Bay, the lowest. Chondrus crispus sampled at Belledune Harbor had significantly higher Pb values than other species collected at the same site. Ascophyllum nodosum had the highest mean levels of Cd and Zn at Belledune, 15 times that at Lobster Bay. Fe occurred at high concentration (>1000 mg/kg) in Fucus sp., C. crispus, and Laminaria longicures collected at the Sydney station. Cu concentrations were lowest in Laminaria spp. by a factor of 2 compared to other species at four of the seven stations. At the control site, A. nodosum and C. crispus had higher levels of Fe and Zn than Laminaria spp. Cd levels in Belledune Harbor plants were 2 to 22 times the values found at other sites; maximum, 10.2 mg/kg in 10-year old A. nodosum (10 times that of the control area). The locations identified as having contaminated seaweed were not areas which experience active commercial harvesting of marine plants. (Cassar-PTT) W88-08682

ABSORPTION AND ELIMINATION OF LIN-DANE BY ASELLUS AQUATICUS (CRUSTA-CEA, ISOPODA),

Paris-11 Univ., Orsay (France). Lab. de Zoologie.

Faris-11 Oliv., Orasy (France). Lab. de 20010gie. E. Thybaud, and S. Le Bras. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 731-735, May 1988. 3 fig. 11 ref.

Descriptors: *Path of pollutants, *Insecticides, *Absorption, *Toxicity, *Lindane, *Bioaccumulation, *Crustaceans, Isopods, Pesticides, Accumulation, Asellus aquaticus.

The toxicity and bioaccumulation of lindane by the isopod, Asellus aquaticus, were determined. The LC50 value was approximately 800 micrograms/ lter. The bioconcentration factor was about 50 and reached a plateau on the third day of the experiment. Decontamination in lindane-free water was rapid; 24 hours after transfer, 40% of the lindane had been eliminated. (Cassar-PTT)

DIETARY EXPOSURE OF BLUEGILLS (LEPOMIS MACROCHIRUS) TO (75) SE: UPTAKE AND DISTRIBUTION IN ORGANS AND TIS-STIES

Miami Univ., Oxford, OH. Dept. of Zoology. For primary bibliographic entry see Field 5C. W88-08688

SEASONAL AND SPATIAL DISTRIBUTIONS OF COPPER, CADMIUM AND ZINC IN THE SEAWATER OF BLANCA BAY, Instituto Argentino de Oceanografia, Buenos Aires. Lab. de Quimica Marina. N. Villa, and A. E. Pucci. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 1, p 67-80, July 1987. 5 fig, 2 tab, 19

Descriptors: "Path of pollutants, "Heavy metals, "Copper, "Cadmium, "Zinc, "Coastal waters, "Estuaries, Spatial distribution, Seasonal distribution, Surface water, Blanca Bay, Argentina, On-site data collections, Pollutant identification, Water temperature, Salinity, Hydrogen ion concentration, Suspended solids, Carbon, Nutrients, Agricultural off, Water pollution source

runoff, Water pollution sources.

To assess the magnitude of metal levels in Argentina in Blanca Bay, seawater and to evaluate future potential changes due to anthropogenic activity, the seasonal and spatial variations of both dissolved and total copper, cadmium, and zinc, as well as temperature, salinity, pH, suspended matter, and particulate carbon were measured in 114 samples taken between April 1980 and April 1981. All parameters measured showed seasonal variations, with similar patterns for all metals, suspended matter, particulate carbon, and nutrients. Both dissolved and total copper and cadmium concentrations increased seawards; runoff from agricultural areas, where pesticides and phosphorus fertilizers containing cadmium and copper are used, could partially explain the high levels of these metals detected at two of the three most seaward sampling stations. Zinc, pH, temperature, and particulate carbon showed nearly uniform levels throughout Blanca Bay. Salinity was found to increase seawards due to dilution effects of freshwater inputs. The major percentage of metals was present as dissolved fractions, and part of these were associated with organic matter. The average levels for metals found in seawater from Blanca Bay were higher than the average values found in geographical areas not affected by anthropogenic inputs; rather, most levels were comparable with data reported for contaminated regions. (Author's abstract)

PLUTONIUM AND CESIUM RADIONU-CLIDES IN SEDIMENTS OF THE SAVANNAH RIVER ESTUARY,

RIVER ESTUARY,
Du Pont de Nemours (E.I.) and Co., Aiken, SC.
Savannah River Lab.
D. W. Hayes, and W. M. Sackett.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 25, No. 2, p 169-174, August 1987. 2 fig, 1 tab,
8 ref. U.S. Department of Energy Contract DEAC09-76SR00001.

Descriptors: *Path of pollutants, *Radioisotopes, *Plutonium, *Cesium, *Sediments, *Marine sediments, *Estuaries, *Savannah River, Tidal marshes, Aquatic productivity, Bottom sediments,

A study was made of the plutonium-239, plutoni-um-240, plutonium-238, and cesium-137 concentra-tions in tidal marsh sediments of the Savannah River estuary. Tidal marshes are identified as spe-River estuary. I rola marsnes are identified as spe-cial locations for plutonium deposition because of the high biological productivity and relative stabil-ity of sediments as compared to channel sediments. The Pu-239 and 240 deposition averaged 3.2 mCi/ square km, which is higher than land-based fallow values of about 2 mCi/square km. The Pu-239,240 values of about 2 incl/square and the pressystem to Cs-137 ratio was about three times higher than fallout deposition estimates, indicating a more rapid desorption of Cs-137 from sediment in the saline waters of the area. (Author's abstract) W88-08714

HYDROCARBON GEOCHEMISTRY OF THE PUGET SOUND REGION: III. POLYCYCLIC AROMATIC HYDROCARBONS IN SEDI-

Washington Univ., Seattle. School of Oceanogra-R. C. Barrick, and F. G. Prahl.

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 2, p. 175-191, August 1987. 4 fig. 3 tab, 35 ref. EPA/Department of Energy Contract DE-AT06-76-EV-70040, EPA Contract R-811249-01-0, and EPA Interagency Agreement EPA-79-D-X0533.

Descriptors: Path of pollutants, "Geochemistry, *Sediments, "Marine sediments, "Hydrocarbons, *Estuaries, Spatial distribution, Water pollution sources, Urban drainage, Runoff, Erosion, Coal, Radioactive dating, Cores, Aromatic compounds, Puper Source

Polycyclic aromatic hydrocarbon (PAH) distributions and sources were characterized in 96 sedi-ment samples from 24 lead-210-dated cores collectment samples from 24 lead-210-dated cores collected at locations in greater Puget Sound. The highest PAH concentrations are found within a few kilometers of several sources including industrial facilities in northern Puget Sound, urban areas in central Puget Sound, and river systems draining coalbearing strata. Regional patterns of combustion-derived PAH in surficial sediments indicate little atmospheric or waterborne exchange of PAH between different regions of the Sound. Significant subsurface maxima in combustion-derived PAH concentrations (Pb-210 dated at the 1950s) occur only in sediment cores collected near urban cenconcentrations (re-210 dated at the 1938) occur only in sediment cores collected near urban cen-ters. Perylene apparently derives from erosion of a terrestrial source with little or no evidence of in situ production at depth in sediment cores. Coal fragments are carriers of a characteristic suite of alkylated phenanthrene, chrysene, and picene derivatives concentrated near river mouths in central and southern Puget Sound. (Author's abstract) W88-08715

SEDIMENT ALIPHATIC HYDROCARBONS IN THE FORTH ESTUARY, Heriot-Watt Univ., Edinburgh (Scotland). Dept. of

ss Organizati

O. D. Ajayi, and M. G. Poxton.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 25, No. 2, p 227-244, August 1987. 5 fig, 5 tab,

Descriptors: *Water pollution sources, *Pollutant identification, *Hydrocarbons, *Aliphatic hydrocarbons, *Estuaries, *Sediments, Sediment concentration, Spatial distribution, Gas chromatography, Mass Spectrometry, United Kingdom, Firth of

The sources and distributions of aliphatic hydro-carbons in sediments from the Forth estuary in carbons in sediments from the Forth estuary in Scotland were examined using gas chromatography and computer-interfaced gas chromatography/mass spectroscopy. The sediments contained hydrocarbons from petrogenic and land-derived biogenic sources. Of the stations examined, the more sandy sediments from Longannet showed the least level of petrogenic pollution. Based on gravimetric data, gas chromatographic, triterpane, and stearane fingerprinting, the Grangemouth refinery complex was identified as a major source of some of the petrogenic hydrocarbons found in the sediments. Resuspension and redistribution of polluted sediments by currents and/or through dredging and dumping of dredge spoil may be additional factors in the high levels of hydrocarbons detected in the Forth estuary. (Shidler-PTT)

BIOGEOCHEMICAL STUDIES ON THE TRANSPORT OF ORGANIC MATTER ALONG THE OTSUCHI RIVER WATERSHED, JAPAN, Mitsubishi-Kasei Inst. of Life Sciences, Tokyo (Japan). Lab. of Biogeochemistry and Sociogeochemistry.

ary bibliographic entry see Field 2K.

ASSESSMENT OF HEAVY METAL CONTAMINATION IN CRASSOSTREA VIRGINICA NATION IN CRASSOSTREA VIRGINICA FROM MARINE FACILITIES, North Carolina Univ. at Wilmington. Dept. of

I Adair

Group 5B—Sources Of Pollution

Northeast Gulf Science NGSCDE, Vol. 9, No. 2, p 135-142, December 1987. 5 fig, 1 tab, 36 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Oysters, *Estuarine environment, *Animal tissues, *Bioaccumulation, Metals, Shellfish, Zinc, Copper, Cadmium, Marinas, Accum

Heavy metal concentrations were determined in oysters collected in three marinas on the coast of southern North Carolina. Mean copper levels in southern North Carolina. Mean copper levels in whole oyster tissue were about 310 ppm at Bradley Creek, 125 ppm at Masonboro, and 50 ppm at Figure Eight (reference site, 40 ppm). Mean zinc levels were about 3300 ppm at Bradley Creek, 2550 ppm at Masonboro, and 1900 ppm at Figure Eight (reference site, 1950 ppm). Cadmium levels were not significantly different from those in the reference site, 3-4 ppm. Probable sources of the heavy metals were marine antifouling paints and sacrificial zinc anodes. (Cassar-PTT)

SOURCES OF NITROGEN AND PHOSPHORUS IN AN ESTUARY OF THE CHESAPEAKE

Agricultural Research Service, Beltsville, MD. Environmental Chemistry Lab. H. M. Kunishi.

Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 185-188, April-June 1988. 5 fig, 3 tab,

Descriptors: "Water pollution sources, "Estuaries, "Nitrogen, "Phosphorus, Chesapeake Bay, Wye River, Nutrients, Agricultural runoff, Nonpoint pollution sources, Nitrates, Nitrites, Ammonium, Phosphates, Rivers.

This study examined the contribution of agriculture to the nutrient (N and P) concentrations in the Wye River, an estuarine tributary of the Chesa-peake Bay. The river drains a watershed that is devoted mainly to farming and is devoid of any sources of municipal and industrial wastes. Water samples were analyzed for nitrate + nitrite and samples were analyzed for nitrate + nitrite and molybdate-reactive P. The concentrations of these forms of nutrients were then examined in relation to sampling site, sample salinity, and time of year. Freshwater entering the river (brackish) from the watershed contained consistently high concentrations of nitrate (about 4 mg/liter) and low concentrations of phosphate (about 40 microgram/liter). Once these nutrients entered the estuarine part of the river however the concentrations of nitrate the river, however, the concentrations of nitrate decreased to low levels within a short distance (500-700 m) from the point of riverine discharge, through both dilution with brackish water and apparent microbial action. The concentrations of lybdate-reactive P increased markedly through release from within estuary sources. Concomitantly, the estuary released large quantities of ammoni-um. The estuary itself, therefore, was the immediate major source of N (as ammonium) and P. (Author's abstract)
W88-08753

RADIOCHEMICAL ANALYSIS OF PHOSPHO-RUS EXCHANGE KINETICS BETWEEN SEDI-MENTS AND WATER UNDER AEROBIC CON-DITIONS.

Kyushu Univ., Fukuoka (Japan). Dept. of Civil

Engineering. H. Furumai, and S. Ohgaki. Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 205-212, April-June 1988. 11 fig, 4 tab, 18 ref, append.

Descriptors: "Path of pollutants, "Fate of pollutants, "Lakes, "Sediments, "Phosphorus, "Aerobic conditions, Lake sediments, Kinetics, Adsorption, Radioisotopes, Model studies, Lake Kasumigaura, Japan, Langmuir equilibrium.

Adsorption-desorption reactions of phosphorus by lake sediments, Lake Kasumigaura, Japan, were studied using radioisotope P32 inorganic phosphate. Exchange rates and amounts of exchangeable P in sediments were measured in aerobic sediments-water batch systems under different pH and P concentration conditions. Exchangeable P

ranged from 6 to 43% of the total P in the indigenous sediments. Increasing pH induced P desorption from sediment. The relationship between the concentration in water and the amount of exchangeable P could be explained by the Langmuir equilibrium model. However, the Langmuir rate equation cannot describe the kinetics of whole exchange reactions. The adsorption-desorption reaction was composed of an exchange reaction and a slow-adsorbed reaction. The exchange reaction has two phases--very rapid reaction and a Lang-muir-type reaction. (Author's abstract) W88-08754

EFFECTS OF FOREST FLOOR LEACHATE ON SULFATE RETENTION IN A SPODOSOL

Sveriges Lantbruksuniversitet, Uppsala. Inst. foer

Sveriges Lantotussuniversitet, Oppsala. Inst. Ioel Ekologi och Miljoevaard. G. R. Gobran, and S. I. Nilsson. Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 235-239, April-June 1988. 1 fig, 3 tab,

Descriptors: *Path of pollutants, *Water pollution effects, *Sulfates, *Acid rain, *Forest soils, *Leachates, Organic matter, Aluminum oxide, Iron

The effect of dissolved substances from the forest floor (Haplorthod soil, A0 horizon) on sulfate mobility in the upper mineral soil (A1/A2 horizon) was investigated. Sulfate retention (sulfate retained in a solid phase) was estimated using distilled water solution and forest floor leachate. Different construction of sulfate (b) to 2000 es S(tites) wares centrations of sulfate (0 to 2000 mg S/liter) were added to both extractants as S35-labeled sodium sulfate. Sulfate retention by the mineral soil (A1/A2) increased linearly with increasing sulfate concentration in the distilled water solution containing centration in the distilled water solution containing up to 500 mg S/liter, whereas retention was zero when the soil was equilibrated with the forest floor leachate containing <250 mg S/liter. However, retention started to increase linearly when the forest floor leachate contained more than 250 mg S/liter. These data indicate that in the range of sulfate found under field conditions, sulfate retention was completely inhibited by the leachate solutions. These data also suggest that the organic tion was completely minorized by the learnate somi-tions. These data also suggest that the organic ligands in the forest floor leachate were competing with sulfate on the exchangeable positive charge sites. Moreover, they may have an inhibitory effect on the growth of some sulfate-aluminum mineral compounds, mainly jurbanite and/or basaluminite. (Cassar-PTT) (Cassar-PTT) (Cassar-PTT)

FORMATION OF A CEMENTED SUBSURFACE HORIZON IN SULFIDIC MINEWASTE, Wisconsin Univ-Madison. Dept. of Soil Science. K. McSweeney, and F. W. Madison. Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p. 256-262, April-June 1988. 6 fig. 3 tab, 26 ref. U.S. Bureau of Mines Grant J0225009.

Descriptors: *Path of pollutants, *Fate of pollutants, *Mine wastes, *Sulfides, Industrial wastes, Lead, Zinc, Chemical precipitation, Iron sulfide,

Wastes deposited during processing of lead-zinc ore in the early 1900s in Wisconsin were studied to determine the changes that had occurred within the ungraded, unvegetated 6-m high, 1.2-ha tailings pile. During the ore roasting process the iron-bearing minerals were converted to a magnetic state for separation; metallic oxides were recovstate for separation; metallic oxides were recovered, and wastes consisting of about 30% iron and 15% sulfide were deposited beside Brewery Creek. Pits dug in the waste pile revealed discrete horizons. The upper three horizons (0-6 cm, 6-16 cm, and 16-53 cm) were generally friable and loose-textured. The 53-100 cm horizon, was dense and cement-like. Its structure was attributed to precipitation of minerals commonly generated by oxidation and translocation of iron sulfide weathering. tion and translocation of iron sulfide weathering tion and transocation of fron stitude weathering products. The inter-aggregate cement was composed largely of gypsum, iron oxides and hydroxides, which precipitate under saturated conditions, whereas the intra-aggregate cement includes jarosite, copiapite, and kalinite, which also precipitate

under saturated conditions, but under more acidic conditions than in the inter-aggregate pores. Hydrated iron sulfates were precipitated in the intra-aggregate pores under conditions promoting upward movement of solutes from the underlying saturated reduced material. The relatively impermeable layer lies above the water table, is laterally contiguous, and may be an effective barrier to significant transport of pollutants to the ground-water. (Cassar-PTT) W88-08758 W88-08758

PERSISTENCE AND MOVEMENT OF PI-CLORAM IN A NORTHERN SASKATCHEWAN WATERSHED,

Agriculture Canada, Regina (Saskatchewan). Rearch Station

A. E. Smith, D. Waite, R. Grover, L. A. Kerr, and . J. Milward.

Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 262-268, April-June 1988. 2 fig, 5 tab,

Descriptors: *Path of pollutants, *Fate of pollutants, *Herbicides, *Pesticides, Picloram, Watersheds, Groundwater pollution, Leachates.

ammer of 1982, 477 ha of a weapons range in northern Saskatchewan were treated with a granular formulation of picloram (4-amino-3,5,6-trichloropicolinic acid) at a rate of 3.38 kg/ha (a.i.). For the next 2 yr the persistence of picloram was monitored in the soil at sites within and outwas monitored in the soil at sites within and outside the treatment area. Picloram was monitored for a 3-yr period in the groundwater at off-target sites and in the surface waters and sediments of a creek and two lakes adjoining the treatment area. Extensive leaching of the herbicide was noted. After 14 months, residues were recovered, from the 60- to 90-cm soil depths, and after 22 months from the 90- to 120-cm layer. After 26 months between 138 and 386 c/ha of sideren was recovered from 118 and 396 g/ha of picloram were recovered from the top 120-cm soil depths. Picloram was detected in the top 30 cm of soils, approximately 1 km from the treatment area, when sampled 14 and 22 months following the initial application. Picloram (0.25-88.3 microgram/liter) was recovered after 35 months from groundwater samples collected at 120 cm from the same off-target sites. This transfer to cm from the same off-target sites. This transfer to nontreated sites was considered to result from a combination of blowing surface soil and ground-water movement from the treated area. Samples of surface waters taken from a lake approximately 1 km from the treatment zone indicated that picloram residues could be detected (0.1-1.15 microgram/liter) in the falls of 1983 and 1984, but not in the summers of 1984 and 1985. Traces of picloram (0.14-0.39 microgram/liter) were recovered in the fall of 1983 and summer of 1985 in creek waters situated approximately 300 m from the edge of the treatment area. Picloram was detected (12 microgram/kg) in only one lake sediment sample at one sampling period. (Author's abstract) W88-08759

DISPOSAL OF SEPTIC TANK EFFLUENT IN CALCAREOUS SANDS,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Animal Production.

For primary bibliographic entry see Field 5D. W88-08760

SULFATE MOBILITY IN AN ACID DANISH FOREST SOIL,

Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.

N. E. von Freiesleben.

Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 278-284, April-June 1988. 4 fig. 4 tab, 54 ref. Commission of the European Communities Grant No. ENV-892-DK.

Descriptors: *Path of pollutants, *Water pollution effects, *Sulfates, *Soil water, *Acid rain, *Forest soils, Leachates, Aluminum oxide, Iron oxide, Denmark, Nitrification, Mineralization, Leachates,

Sources Of Pollution-Group 5B

Sulfate leaching was studied in the laboratory in undisturbed soil cores taken in a Typic Udipsamment under spruce forest. The soil cores were watered with natural throughfall water (pH 3.6) or with throughfall acidified to pH 3.3 or 2.8 with a mixture of sulfuric and nitric acid (1:1, molar basis). A total of 660 mm of throughfall was applied during 11 months. The technique of using soil cores produced increased nitrification and mineralization in the soil, causing a continuous acid production in the soil cores and decrease in the leachate pH during the experiments. Soil solution concentrations of sulfate were in the range of 0.4 to 1.5 mmol/liter, total aluminum 0.2 to 1.5 mmol/liter, total aluminum 0.2 to 1.5 mmol/liter, and pH 3.5 to 4.1. Stability diagrams using Al and sulfate activities and pH indicate that precipitation of a solid phase with the composition of AlOHSO4 may control the Al and sulfate activities in the soil solutions in the Bw horizon but not in the Aphorizon. The equilibrium constant for this basic Al sulfate was estimated at 20 C, pKs = 17.36 and at 5 C, pKs = 17.05. The S35-labeled sulfate was added once to the same soil cores followed by 15 C, pKs = 17.95. The S35-labeled sulfate was added once to the same soil cores followed by 15 C, pKs = 17.05. The s35-labeled sulfate was retained in the soil cores was determined. From 38 to 100% of the applied S35-labeled sulfate was retained in the soil cores, and of this amount 32 to 63% was found in the top of the Bw horizon, which was highest in free Al and Fe oxides. The studied soil did not accumulate sulfate under ambient field conditions. In the laboratory, however, sulfate accumulation was demonstrated when the studied soil did not accumulate sulfate under ambient field conditions. In the laboratory, however, sulfate accumulation was demonstrated when the soil was exposed to increased sulfate load and temperature as well as decreased pH, showing that sulfate sorption/desorption may buffer variations in sulfate concentrations in soil solutions, and thereby delay effects of acidification on cation leaching. (Author's abstract) W88-08761

CHEMICAL AND DECOMPOSITION CHARACTERISTICS OF ANAEROBIC DIGESTER EFFLUENTS APPLIED TO SOIL, Southeast Kansas Branch Experiment Station, Par-

For primary bibliographic entry see Field 5D. W88-08762

ATMOSPHERIC SULFUR DEPOSITION TO AGRICULTURAL LAND IN NORTHEASTERN OHIO,

OHIO; Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences. M. J. Morra, and W. A. Dick. Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 323-329, April-June 1988. 3 fig. 7 tab, 37 ref. Ohio Air Quality Development Authority Grant OSURF 714851.

Descriptors: *Acid deposition, *Fate of pollutants, *Water pollution sources, *Air pollution, *Acid deposition, *Sulfur, Deposition, Agriculture, Ohio, Soil contamination.

In a field experiment in northeastern Ohio, the amount of sulfur in dry deposition was determined over a three-year period using 20 lysimeters (4.8 m by 1.7 m) cropped with soybean. Two treatments consisting of tillage (conventional or no-tillage) and elemental S addition (0 or 50 kg/ha) were applied to the lysimeters. Sulfur inputs to the lysimeters as precipitation and agricultural amendments and S outputs, as runoff and leachate waters, were determined using ion chromatography or alkaline oxidation techniques. The net S output (total outputs minus measured inputs) was considered to equal dry deposition. Precipitation and agricultural amendment inputs of S were 10.2 and 3.8 kg/ha/yr, respectively. In comparison, S in dry deposition ranged from 14 to 26 kg/ha/yr for the conventional tilled treatment and from 25 to 39 kg/ha/yr for the no-tilled treatment, with the upper values of al tilled treatment and from 25 to 39 kg/ha/yr for the no-tilled treatment, with the upper values of these ranges considered most accurate. Dry depo-sition is clearly as important as precipitation in contributing to the total S load at this location. A sulfur dry deposition estimate of only 15 kg/ha/yr was made based on average deposition velocity an ambient SO2 levels. Total deposition models, which rely on dry deposition estimates obtained by

the use of SO2 concentrations and an average deposition velocity, may yield inaccurate values of total S additions to the earth's surface. (Cassar-PIT W88-08763

ANAEROBIC MICROBIAL METHYLATION OF INORGANIC TIN IN ESTUARINE SEDI-MENT SLURRIES, Maryland Univ., Solomons. Center for Environ-mental and Estuarine Studies.

C. C. Gilmour, J. H. Tuttle, and J. C. Mear Microbial Ecology MCBEBU, Vol. 14, No. 3, p 233-242, 1987. 1 fig, 3 tab, 39 ref. NSF Grant OCE

Descriptors: *Microbiological studies, *Estuaries, *Anaerobic conditions, *Tin, *Estuarine environ-ments, *Methylation, Bacteria, Sediments, Chemi-cal reactions, Heavy metals.

Estuarine sediment slurries and microorganisms were examined for the ability to methylate inorganic tin. Under controlled redox conditions, tin was methylated only in oxygen-free sediment slurries. Monomethyltin usually comprised greater than 90% of the alkyltin products formed, although dimthyltin was also produced. Autoclaved anoxic sediments did not produce organoitins. Several bacterial cultures, most notably sulfate-reducing bacteria isolated from anoxic estuarine sediments, formed mono- and dimethyltin from inorganic tin in the absence of sediment. The results suggest that inorganic methylation in estuarine environments is an anaerobic process catalyzed primarily by sulfate-reducing microorganisms. (Author's abstract) W88-08798

ECOLOGY OF VIBRIO CHOLERAE IN THE FRESHWATER ENVIRONS OF CALCUTTA,

National Inst. of Cholera and Enteric Disease Calcutta (India).

G. B. Nair, B. L. Sarkar, S. P. De, M. K. G. b. vant, b. L. Satkar, S. 1 S. Chakrabarti, and R. K. Bhadra.

Microbial Ecology MCBEBU, Vol. 15, No. 2, p 203-215, 1988. 1 fig, 4 tab, 35 ref.

Descriptors: *Ecology, *Public health, *Bacteria, *Vibrio, *Lakes, *Ponds, *Sewer systems, *Sea-al variation, *Temperature effects, *Hydrogen ion concentration, Sediments, Calcutta, India.

Seasonal incidence of Vibrio cholerae was moni-tored for a year in a man-made freshwater lake, an open sewage canal, and a pond composed of rain-water accumulations, located in Calcutta. V. chowater accumulations, located in Caretta. V. Chilerae was found in all sites. It exhibited a distinct bimodal seasonal cycle in the lake with a primary peak in August-September and a secondary peak in May-June. Correlation with environmental parampeak in August-September and a secondary peak in May-Junc. Correlation with environmental parameters revealed that temperature and, to a certain extent, pH were the important factors governing the densities of V. cholerae. In the lake, sediment samples harbored high densities of V. cholerae immediately after months when peak counts were observed in plankton, suggesting a cycle of cells between sediment and water. At the other sampling areas, no defined seasonality was observed at these severely polluted sites throughout the study period, including the winter months. All the 15 water samples passed via the ligated loop of rabbits yielded pure cultures of V. cholerae, indicating that the rabbit intestine selects out V. cholerae from a mixed flora. Uniformly high isolation rates of V. cholerae were observed from brackish water and freshwater species of export quality prawns. V. cholerae was found to be abundant and was represented by 32 individual Louisiana State University (LSU) servoyars, extending the existing LSU serological scheme from 50 to 52 serovars. University (LSU) serovars, extending the existing LSU serological scheme from 50 to 52 serovars. The 01 serovar could not be isolated from any of the samples examined in this study. It was concluded that V. cholerae non-01 is common in the freshwater environs of Calcutta. (Author's ab-W88-08805

CHANGES IN NITROGEN, PHOSPHORUS AND PHYTOPLANKTON COMPOSITION DURING THE PAST DECADE IN THE BAY OF ARATU SALVADOR (BAHIA) BRAZIL,

Dow Chemical U.S.A., Midland, MI. Mammalia and Environmental Toxicology. U. M. Cowgill.

Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 1, p 1-14, November 1987. 3 fig. 5 tab, 15 ref.

Descriptors: *Industrial development, *Water pollution effects, *Nitrogen, *Phosphorus, *Phytoplankton, *Brazil, *Water pollution sources, *Wastewater disposal, Diatoms, Algae, Chemical industry, Cyanophyta.

Data from two surveys of the chemical, biological, and physical characteristics of the Bay of Aratu on the north coast of Brazil were compared. In the first (baseline) survey in 1975 at least 96.7% of the phytoplankton were diatoms and the region surrounding the Bay supported only some itinerant fisherman. By 1978 when the second survey was conducted, this region contained a population in excess of 10,000. All human waste was dumped in the Bay and the nitrogen and phosphorus content increased noticeably. By 1982, only 61% of the phytoplankton were diatoms and blue-green algaewere becoming increasingly more prevalent. No relationship was found between nitrogen and phosphorus. However, a significant straight line relationship was encountered between the concentration of nitrogen and the percentage of blue-green alga. The atomic N:P concentration indicates that the primary source of both elements is human the primary source of both elements is hu sewage. (Miller-PTT) W88-08808

APPLICATION OF THE FINITE ELEMENT GROUNDWATER MODEL FEWA TO A RADIOACTIVE WASTE DISPOSAL SITE,

Oak Ridge National Lab., TN. Environmental Sciences Div.

E. C. Davis, and P. M. Craig. Applied Mathematical Modeling AMMODL, Vol. 12, No. 2, p 141-153, April 1988. 12 fig, 5 tab, 11

Descriptors: *Groundwater movement, *Porous media, *FEWA, *Aquifers, *Path of pollutants, *Model studies, *Finite element method, *Radio-active waste disposal, *Landfills, *Solute transport, *Groundwater pollution, Hydrology, Simulation, Prediction, Mathematical studies, Hydraulic conductivity, Rainfall.

A finite element model for water transport through A finite element model for water transport through porous media (FEWA) has been applied to the unconfined aquifer at the Oak Ridge National Lab-oratory Solid Waste Storage Area 6 Engineered Test Facility (ETF). The model was developed in 1983 as part of a shallow land burial technology 1983 as part of a shallow land burtal technology research project and was previously verified using several general hydrologic problems for which an analytic solution exists. Model application and calibration consisted of modelling the ETF water table for three specialized cases: a one-dimensional steady-state simulation, a one-dimensional transient simulation, and a two-dimensional transient simulation. simulation, and a two-uninestoliar drainsent simula-tion. In the one-dimensional steady-state simula-tion, the FEWA output accurately predicted the water table during a long period in which there were no human-induced or natural perturbations to the system. The input parameters of most impor-tance for this case were hydraulic conductivity and acuifer bottom elevation. In the two transient tance for this case were hydraulic conductivity and aquifer bottom elevation. In the two transient cases, the FEWA output has matched observed water table responses to a single rainfall event occurring in February 1983, yielding a calibrated finite element model that is useful for further study of additional precipitation events as well as con-taminant transport at the experimental site. (Au-bock eletrativ) thor's abstract) W88-08848

DEVELOPMENT OF A WATER QUALITY PLANNING MODEL USING UTM SQUARE-GRID SYSTEM,
Institut National de la Recherche Scientifique,

Sainte-Foy (Quebec).

Group 5B-Sources Of Pollution

For primary bibliographic entry see Field 5G. W88-08853

SEDIMENTS AS A SOURCE FOR CONTAMINANTS

Institute for Soil Fertility, Haren (Netherlands). W. Salomons, N. M. de Rooij, H. Kerdijk, and J. Bril.

Hydrobiologia HYDRB8, Vol. 149, p 13-30, June 1987. 14 fig, 1 tab, 49 ref.

Descriptors: *Sediments, *Reviews, *Sedimentwater interfaces, *Water chemistry, *Sedimentation, *Lake sediments, *Pollutants, *Heavy metals, *Water pollution sources, Path of pollutants, *Metals.

This review article covers the processes affecting trace metals in deposited sediments. The sediment-water system can be divided in three parts: the oxic layer, the anoxic layer and the oxic-anoxic interface. Available data show that trace metals like Cu. Zn and Cd occur as sulfides in marine and estuarine anoxic sediments. Calculations show that organic complexation is unlikely and the dominant species are sulfide and bisulfide complexes. Chromium and arsenic are probably present as adsorbed species on the sediments; their concentrations in the pore waters, therefore depend on the concentrations in the sediments. The oxic-anoxic interface plays the major role in the potential flux of trace metals from the sediments. However this interface is not well studied at present. Changes from an anoxic to an oxic environment as occurs during dredging and land disposal of contaminated sediments may cause a remobilization of some trace metals. (Author's abstract)

BIOLOGICAL PROCESSES INVOLVED IN THE CYCLING OF ELEMENTS BETWEEN SOIL OR SEDIMENTS AND THE AQUEOUS ENVIRONMENT.

ENVIRONMENT,
Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
J. M. Wood.

Hydrobiologia HYDRB8, Vol. 149, p 31-42, June 1987. 6 fig, 1 tab, 23 ref.

Descriptors: *Biochemistry, *Sediments, *Path of pollutants, *Heavy metals, *Toxicity, *Soil chemistry, *Metals, *Alkalin earth, *Alkaline earth metals, *Cycling nutrients, Biological properties, Aquatic environment, Ligands.

The biochemical basis for resistance to toxicity is complicated by the great variety of reactions at the molecular and cellular levels even in closely related organisms and tissues. Several strategies for resistance to intoxication have been identified. Metal ion interactions in biology can be divided into three classes representing fast, intermediate and slow exchange with biological ligands. Examples of those elements in fast exchange include the alkali metals Na(+) and K(+), the alkali earth metals Ca (2+) and Mg(2+), and, of course, H(+). Those which can sometimes be in intermediary exchange are Fe(2+) and Mn(2+). Examples of those in slow exchange are generally in the active sites of metalloenzymes, e.g., Fe(3+), Zn(2+), Ni(2+). Cu(2+). The cycling of one essential element (nickel) and one non-essential element (mercury) are reviewed with special emphasis on their mobilities in the event of in situ sediment contamination. (Author's abstract) W88-08858

PARTITIONING OF TRACE METALS IN SEDI-MENTS: RELATIONSHIPS WITH BIOAVAI-LABILITY.

Quebec Univ., Sainte-Foy. A. Tessier, and P.G.C. Campbell. Hydrobiologia HYDRB8, Vol. 149, p 43-52, June 1987. I fig., 3 tab, 49 ref.

Descriptors: *Bioavailability, *Bottom sediments, *Path of pollutants, *Sediments, *Trace metals, *Bioaccumulation, *Chemical reactions, *Model studies, *Sediment-water interfaces, Partitioning.

In recent years, the fluxes of many trace metals from terrestrial and atmospheric sources to the aquatic environment have increased. The resulting accumulation of certain metals in the food chain, their toxicity to aquatic organisms and their potential health hazard in drinking water supplies have led to an upsurge in interest on the part of both environmental scientists and governmental authorities. As a result of complex physical, chemical and biological processes, a major fraction of the trace metals introduced into the aquatic environment is found associated with the bottom sediments, distributed among a variety of physico-chemical forms. As these different metal forms will generally exhibit different chemical reactivities, the measurement of the total concentration of a particular metal provides little indication of potential interactions with the abiotic or biotic components present in the environment. In principle, the partitioning of sediment-bound metals could be determined both by thermodynamic calculations (provided equilibrium conditions prevail) and by experimental techniques. The modelling of sediment-bound metals is far less advanced than is that of dissolved species, primarily because the thermodynamic data needed for handling sediment-interstitial water systems are not yet available. The partitioning of a metal among various fractions obtained by experimental techniques (e.g., sequential extraction procedures) is necessarily operationally defined. These methods have, however, provided significant insight into the physico-chemical factors influencing the bioavailability of particulate trace metals; some of these factors are discussed. (Author's abstract) W88-08859

INTERACTIONS BETWEEN SEDIMENT CON-TAMINANTS AND BENTHIC ORGANISMS, International Joint Commission-United States and

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Regional Office.

For primary bibliographic entry see Field 5C. W88-08860

HUMAN POPULATION: AN ULTIMATE RE-CEPTOR FOR AQUATIC CONTAMINANTS, Michigan Dept. of Public Health, Lansing. Center for Environmental Health Sciences.

H. E. B. Humphrey. Hydrobiologia HYDRB8, Vol. 149, p 5-12, June 1987. 10 fig, 10 ref.

Descriptors: *Foods, *Polychlorinated biphenyls, *Path of pollutants, *Population exposure, *Pollutants, *Water pollution, *Lake Michigan, *Food chains, *Organic compounds, Tissue analysis, Path of pollutants, Toxicity, Food habits, Bioaccumulation, Pesticides.

Human consumption of sport-caught fish represents a significant route of exposure to aquatic chemical contaminants. To investigate this, a cohort of Michigan residents was established and evaluated in 1974 and 1981. PCB, DDT and DDE concentrations dominated the eleven contaminants found in participant blood specimens. Those who regularly ate Lake Michigan fish had serum PCB levels up to 30 times greater than those who did not eat these fish. Serum levels briefly increased following each fish meal, correlated with annual fish consumption and celevated levels in fisheaters have toxic properties. It appears that the human population can be a final receptor for persistent toxic chemical contaminants found in the environment. (Author's abstract)

ACCELERATING RECOVERY OF THE MER-CURY-CONTAMINATED WABIGOON/ENG-LISH RIVER SYSTEM, Ontario Ministry of the Environment, Thunder

Ontario Ministry of the Environment, Thunder Bay (Ontario). For primary bibliographic entry see Field 5G. W88-08865

CASE STUDY: BAY OF POZZUOLI (GULF OF NAPLES, ITALY).

ENEA, La Spezia (Italy). Dipt. Protezione Ambientale e Salute dell'Uomo.

V. Damiani, R. Baudo, S. De Rosa, R. De Simone, and G. Ferretti.

Hydrobiologia HYDRB8, Vol. 149; p 201-211, June 1987. 7 fig, 5 tab, 9 ref.

Descriptors: *Path of pollutants, *Sediments, *Heavy metals, *Italy *Polychlorinated biphenyls, *Hydrocarbons, *DDT, *Chlorinated hydrocarbons, *Bioaccumulation, Carbon, Nitrogen, Marine fisheries, Pozzuoli Bay, Biodegradation, Bioassay, Water pollution sources.

The Centro Richerche Energia Ambiente examined the sediments of Pozzuoli Bay for contamination of metals, organic matter, PCBs, PAHs and DDT. The physical characteristics of surficial sediments reflected volcanic and industrial activity in the region. Elevated concentrations of Cu, Fe, Hg, Mn, Pb and Zn were present in the sediments of littoral area near industrial centers. Carbon/nitrogen ratios (> 20) of sediments indicated that organic matter was of an allochthonous origin. Industrial and agricultural activity in the area was reflected through elevated concentrations of PCBs, PAHs and DDT. Although the region has maintained an important fishing industry, there was no evidence of change in the commercial fish catch at the Port of Pozzuoli from 1979 to 1983 which could be correlated with contaminated sediments. Future work will focus on the bioaccumulation of contaminants. (Author's abstract)

WHAT WAS LEAKING FROM A HAZARDOUS WASTE DUMP IN NIAGARA FALLS, N.Y.,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.

R. A. Hites.

Analytical Chemistry ANCHAM, Vol. 60, No. 10, p 647A-648A, 650A, May 15, 1988. 4 fig, 5 ref.

Descriptors: *Path of pollutants, *Niagara Falls, *Leaching, *Toxic wastes, *Hazardous wastes, *Water pollution sources, *Waste dumps, Toxicity, Lakes, Chemical analysis, *Water pollution, Gas chromatography, Mass spectrometry, New York, Lake Ontario,

The city of Niagara Falls, N.Y., is the home of several toxic waste disposal sites, the most famous of which is Love Canal. Although less well known, the Hyde Park dump is equally noxious. This hazardous-waste dump was operated by the Hooker Chemical Company from about 1953 to 1975. Approximately 55,000 tons of halogenated waste were buried at this site, which is just north of the city. The Hyde Park dump is drained by Bloody Run Creek. In the early stages of a study of the impacts of hazardous-waste dumps on Lake Ontario, it was important to identify the structures of the organic compounds leaking from the Hyde Park dump. Of special interest were compounds with 'odd' structures that could serve as long-range markers of the effluent from this particular dump. The first step consisted of sampling the sediment. The sediment samples were extracted, then analyzed by gas chromatography/mass spectrometry. The mass spectra of several common compounds (such as chlorobenzenes, chlorotoluenes and chlorophenols) were easily interpreted, but the spectra of two unusual compounds attracted considerable attention. In both cases, the presence of fragment ions indicated that the molecules contained one or more fluorine atoms. Further study of the mass spectra of both compounds along with research of the literature dealing with the dump site used by Hooker Chemical Company was needed to determine the identity of the 2 compounds. Compound A was revealed to be 4-chloro(trifluoromethy) group on the other. Another unusual compound related to A and B was discovered some time later after examining GC/MS data from extracts of fish caught in the Niagara River downstream from the city of Niagara Falls and from extracts of fish caught in the Niagara River downstream from the city of Niagara Falls and from extracts of fish caught in the Niagara River downstream from the city of Niagara Falls and from extracts of fish caught in the Niagara River downstream from the city of Niagara Falls and

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atoms and two trifluoromethyl groups. Because of their unusual structures, these compounds were and are able to serve as tracers of material leaking from the Hyde Park dump. (Brock-PTT)

COAL GAS PLANT WASTES: REMNANT OF

AN ERA,
BCM Engineers, Inc., Plymouth Meeting, PA.
B.R. Cushing, and J. W. Fowler.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 21, No. 3, p 11-15, May-June

Descriptors: *Fuel, *Water pollution sources, *Waste disposal, Gas manufacturing facilities, Fossil fuel by-products, Path of pollutants, Wells, Surface water, Groundwater pollution.

From 1890 to 1950, more than 1,500 gas manufacturing facilities operated in communities in the U.S. The plants used fossil fuels (primarily coal) to produce gas for local heating and lighting purposes. By-products of the manufacturing process amounted to 11 billion gallons of tar nationally. Of this, 2.6 billion gallons are assumed to have been consumed at the site, sold without sales records, or discarded. This discarded material, which may have been disposed of at the plant site, may be of concern in residential communities, since in many cases it remains onsite for years after the facility has closed. Coal tar materials can contaminate water supplies beneath a former plant site, or contamination may migrate offsite to adjacent water supply wells or surface water bodies. The processes involved in the production of gas and its associated by-products are discussed, and the mechanism supply wells or surface water bodies. The process-es involved in the production of gas and its associ-ated by-products are discussed, and the mechanism by which these by-products as wastes enter the environment is given. The conduction of a site investigation as well as the problems of site resto-ration are examined. (Brock-PTT) W88-08901

NITRATE PROBLEM IN GROUNDWATER: WHAT CAN BE DONE, Wright (R.E.) Associates, Middletown, PA. N. E. Wehler.

N. E. Wehler. Water Pollution Control Association of Pennsylva-nia Magazine, Vol. 21, No. 3, p 19-22, May-June 1988.

Descriptors: *Groundwater pollution, *Fertilizers, *Manure, *Nitriates, *Water pollution control, *Nutrients, Nutrient management, Agricultural chemicals, Water pollution sources.

During the past decade, worldwide studies have shown that nitrates that are used as fertilizer in routine agricultural practices are infiltrating the groundwater and contaminating wells. In many areas, the increased application of commercial ni-trate fertilizers and the mismanagement of nitratetrate fertilizers and the mismanagement of nitrate-rich manure have resulted in an overload of nitrate-nis soil. Excess nitrates leach into the groundwater and adversely affect drinking water supplies. Since nitrate is converted to a potentially toxic substance (sirgich) in the disease in automatic forter. (nitrite) in the digestive systems of human infants and some livestock, its presence in the groundwar-er is a serious problem. While a complex combina-tion of factors have contributed to the nitrate contamination problem, two major factors have been identified. One is that a greater volume of manure is being generated per farm, since animal populations of individual farms have significantly increased over the years. The second is the substantial growth in the use of commercial fertilizers since the 1960's, which have all but replaced since the 1960's, which have all but replaced manure as the primary nitrate fertilizer. Compounding the problem of increased production of manure and use of fertilizers are the factors of overapplication and misapplication. To assist farmers in finding solutions to these problems, a new science is beginning to emerge: Nutrient Management. The concept of Nutrient Management is discussed and some practical applications of this science are illustrated. (Brock-PTT) W88-08902

SIMPLISTIC MASS BALANCE OF STORM-WATER POLLUTANTS FOR TWO URBAN CATCHMENTS,

University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Pro-

gramme.
D. Stephenson, and I. R. A. Green.
Water SA WASAD, Vol. 14, No. 2, p 93-98, April 1988. 2 fig, 7 tab, 17 ref.

Descriptors: *Urban runoff, *Catchment areas, *Storm runoff, *Water pollution sources, South Africa, Suburban areas, Pollution load, Nitrates.

Two catchments in Johannesburg, one a densely built-up city catchment and the other a suburban catchment, were monitored under a storm-water research program. Continuous flow and conductiv-ity measurements were taken, and spot sampling for selected ions made during storms. Pollution loading was highest from the city catchment and in both cases storm runoff carried most of the pollu-tion. Net atmospheric washout and fallout was of tion. Net atmospheric washout and fallout was of the same order as washoff of pollutants in the case of the suburban catchment. Nitrates exhibited an increase. (Author's abstract) W88-08907

OIL SLICK TRANSPORT IN RIVERS.
Clarkson Coll. of Technology, Potsdam, NY.
Dept. of Civil and Environmental Engineering.
H. T. Shen, and P. D. Yapa.
Journal of Hydraulic Engineering JHEND8, Vol.
114, No. 5, p 529-543, May 1988. 5 fig. 3 tab, 34 ref,
1 append. US Army Corps of Engineers Contract
No. DACA33-85-C-0001.

Descriptors: *Path of pollutants, *Model studies, *Rivers, *Cleanup operations, *Environmental effects, *Oil spills, *Fate of pollutants, Lagrangian discrete-parcel algorithm, Computer models, River flow, Great Lakes, Algorithms, Advection, Mechanical spreading, Horizontal turbulent diffusion, Evaporation, Dissolution, Shoreline deposition.

A computer model for oil slick transformation is rivers is developed and applied to simulate the fate of oil spills in the connecting channels of the upper Great Lakes. In the model, the transport of the surface oil slick is simulated by a Lagrangian discrete-parcel algorithm. The model simulates either continuous or instantaneous oil spills and can be used for both onen water and ice-covered condicontinuous or instantaneous oil spills and can be used for both open water and ice-covered conditions. Oil slick transformation processes considered in the model include advection, mechanical spreading, horizontal turbulent diffusion, evaporation, dissolution, and shoreline deposition. The model can be used to develop cleanup measures in the case of an actual spill and to assess likely environmental impacts of possible spills. (Author's abstract) stract) W88-08917

SOME PECULIARITIES OF THE TRACE-METAL DISTRIBUTION IN BALTIC WATERS

METAL DISTRIBUTION IN BALTIC WATERS AND SEDIMENTS, Akademie der Wissenschaften der DDR, Rostock-Warnemuende. Inst. fuer Meereskunde. For primary bibliographic entry see Field 2L. W88-08940.

MERCURY IN THE NORWEGIAN FJORD FRAMVAREN,

Swedish Environmental Research Inst., Goeteborg. A. Iverfeldt. Marine Chemistry MRCHBD, Vol. 23, No. 3/4, p 441-456, April 1988. 5 fig, 5 tab, 13 ref.

Descriptors: *Mercury, *Fjords, *Estuaries, *Geochemistry, *Framvaren Fjord, *Path of pollutants, *Fate of pollutants, *Anoxic conditions, Oxidation reduction chemistry, Seasonal variations, Norway.

Depth profiles of various mercury fractions in the permanently anoxic Framvaren Fjord, southern Norway, were determined on two occasions: September 1983 and February 1985. The mercury fractions were operationally defined as 'dissolved gaseous' Hg (DGM), 'reactive' Hg, 'reactive + non-reactive' Hg and 'total' Hg. The concentrations of Hg were generally higher during fall 1983 than winter 1985. The highest Hg concentrations

in the profiles, independent of fraction, were found at the redox cline in 1983. No such general trend was revealed in 1985. The DGM concentration was revealed in 1985. The DGM concentration down to the redox boundary were between 0.3 and 6 ng per 1 (1983) and 0.01 and 0.4 ng per 1 (1985). In 1983, the concentrations of dissolved 'reactive' Hg were in the range of 0.3-25 ng per 1. The concentrations of the dissolved 'reactive' + non-reactive' Hg fraction in the depth profile for 1983 and 1985 were in the ranges 1.5-30 ng per 1 and 0.2-1.7 ng per 1, respectively. No significant difference in 'reactive' + non-reactive' Hg was found between filtered and unfiltered samples collected in the winter of 1985. In 1983, the 'total' Hg concentrations in filtered samples from the near-surface trations in filtered samples from the near-surface water were usually twice the 'reactive + non-reactive' Hg concentrations. The same relationship reactive' Hg concentrations. The same relationship was found in unfiltered samples in 1985. Release from mercury-containing particles, due to the drastic change in the redox potential and a large biological activity are suggested as being responsible for the enrichment at the redox cline in the fall. The lower Hg values in the winter may be a result of the absence of direct atmospheric deposition, low input of Hg from the catchment area, low biological activity and low sediment flux in the water column. In the oxic surface water, a positive correlation between the concentration of DGM, or labile volatile precursors to DGM, and the biological productivity is indicated. The concentration of cal productivity is indicated. The concentration of DGM, probably elemental Hg, in the surface water of the Framvaren indicates an efflux to the atmosphere. (Author's abstract) W88-08941

NUCLEATION OF SULFURIC ACID-WATER AND METHANESULFONIC ACID-WATER SO-LUTION PARTICLES: IMPLICATIONS FOR MOSPHERIC CHEMISTRY OF ORGANO-SULFUR SPECIES.

California Inst. of Tech., Pasadena. Dept. of Chemical Engineering.

Chemical Engineering.

S. M. Kreidenweis, and H. Seinfeld.

Atmospheric Chemistry ATENBP, Vol. 22, No. 2, p 283-296, February 1988. 14 fig., 3 tab, 41 ref, 2 append. NSF Grant ATM -8503103.

Descriptors: *Aerosols, *Sulfuric acid, *Methane-sulfonic acid, Chemistry of precipitation, *Acid rain, *Path of pollutants, *Model studies, Atmos-pheric water, *Nucleation, *Dimethyl sulfide, *Humid climates, Prediction, Humidity, Binary nu-cleation theory, Aqueous acids, Aerosol formation rate, Mathematical models, Organosulfur species, Integral models.

Binary nucleation theory is applied to the forma-tion of aqueous sulfuric acid and aqueous methane-sulfonic acid particles and the relative rates of aerosol formation in humid atmospheres are com-pared. An integral model is presented that de-scribes the nucleation of solution particles, aerosol growth, and condensable vapor source and deple-tion rates. To extend this model, the water activity of the ternary solution, sulfuric acid-methanesul-fonic acid-water, are estimated, and growth of the nucleated aerosol by incorporation of both types of acid is considered. Predictions of both forms of the model are compared with the experimental results of Hatakeyama and coworkers for the photooxidation of dimethylsulfide in humid air. (Author's abstract) W88-08946

NUMERICAL STUDIES OF ACIDIFICATION PROCESSES WITHIN AND BELOW CLOUDS WITH A FLOW-THROUGH CHEMICAL REACTOR MODEL,

Argonne National Lab., IL. Environmental Re-

M. S. Hong, and I. Y. Lee. Atmospheric Chemistry ATENBP, Vol. 22, No. 2, p 297-305, February 1988. 11 fig. 9 tab, 15 ref.

Descriptors: *Chemistry of precipitation, *Numerical analysis, *Clouds, *Path of pollutants, *Model studies, *Sulfates, *Nitrates, *Air pollution, *Deposition, *Wet oxidation process, *Acid rain, Precipitation, Microclimatology, Acidification, Flow-

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through chemical reactor model, Partitioning of pollutants, Atmospheric pollutants, Ions.

A flow-through chemical reactor model was employed to assess the importance of various oxida-ition reactions and cloud processes on wet removal and redistribution of atmospheric pollutants, and to investigate the effect of in-cloud acidification on precipitation chemistry at the surface. Preliminary results indicate that in-cloud acidification accounts for more than 60% of the wet deposited acids derived from acidification of initial SO2, that 42-57% of water-soluble, non-reactive NH3 and HNO3 are removed by wet deposition. The pseudo-first-order conversion rate of SO2 to SO4(-) ranges from 3 to 25% per h depending on initial and boundary conditions. Sensitivity studies have been carried out to test the importance of time evolution of clouds on partitioning of pollutants in the atmosphere, and to investigate the variability of precipitation chemistry due to changes in rate constants. The distributions of NH3 and HNO3 depend largely on the cloud microphysical A flow-through chemical reactor model was em HNO3 depend largely on the cloud microphysical parameters, whereas the distributions of H2O2 and parameters, whereas the distributions of HZOZ and SOZ depended largely on initial conditions of both species. Individual physical and chemical mechanisms can determine the overall rate of sulfate wet deposition at different stages of cloud evolution. (Author's abstract) W88-08947

TIME-TRENDS OF SULFATE AND NITRATE IN PRECIPITATION IN NORWAY (1972-1982), Bergen Univ. (Norway). Geofysisk Ins E. Berge.

Atmospheric Chemistry ATENBP, Vol. 22, No. 2, p 333-338, February 1988. 4 fig, 3 tab, 14 ref.

Descriptors: "Sulfates, "Nitrates, "Precipitation, "Acid rain, "Norway, "Path of pollutants, Time series analysis, Air pollution, "Chemistry of precipitation, Seasonal variation, Emission rates, Splithalf method, Seasonal distribution, United Kingdom, Europe, North America.

A time-trend analysis of excess-sulfate (excSO4(--)) A time-trend analysis of excess-sulfate (excSO4(--)) and nitrate (NO3(-)) in precipitation at three Norwegian background stations over the period 1972-1982 is shown. Parameterized corrections, for transport direction, precipitation amount, and seasonal cycle are applied and 'split-half' method is used to estimate the uncertainty of the trend analysis. Despite a large decrease (3.4% per a) in the emission rates in the United Kingdom no corresponding negative excSO4(-) trend is found from the transport direction. In airmasses from remote areas, like the Atlantic and Norwegian seas, a marked negative excSO4(-) trend is found, in accordance with reduce emission rates in middle Europe and North America. Further, increased emission rates of nireduce emission rates in middle Europe and North America. Further, increased emission rates of ni-trogen compounds are reflected in a positive NO3(-) trend in southern Norway. The most northerly station indicates, however, a decrease in NO3(-). (Author's abstract) W88-08948

ACID RAIN IN SOUTHWESTERN CHINA, Academia Sinica, Beijing (China).
D. Zhao, J. Xiong, Y. Yu, and W. Chan.
Atmospheric Chemistry ATENBP, Vol. 22, No. 2, p 349-358, February 1988. 6 fig. 8 tab, 19 ref.

Descriptors: *Acid rain, *China, *Path of pollut-ants, *Yangtze River, *Chemistry of precipitation, *Air pollution, *Hydrogen ion concentration, Soil types, Acidic soils, Aerosols, Chemical composi-tion, Airborne particles, Precipitation.

Acid rain and acidification of the environment Acid rain and acidification of the environment have been environmental issues of concern in China in recent years. Approximately 90% of the monitoring stations with a mean pH of less than 5.6 are located south of the Yangtze River. In this account, new research data have been combined with those published originally in Chinese to give an overview of the acid rain picture in southwestern China, a region with the most serious acid rain problem in China. Results for southwestern China are presented in comparison with data from northern parts of China to demonstrate the spatial variability, and to show the impact of NH3, airborne

particles and soil types on rain acidity. Rain acidity in urban areas originates primarily from below-cloud scavenging of SO2 emitted from local sources. Particulates, together with the ammonia in air, make up the atmospheric buffering capacity. The geographical distribution of rain acidity in China can roughly be explained by the geographical distribution of soil pH, despite the serious contribution of SO2 in air. Even though long-distance transport of acidifying substances does not play a substantial role in acid rain in southwestern China, there is evidence of acid rain in remote areas. (Miller-PTT)

TREND AND SEASONAL VARIATION OF PRECIPITATION CHEMISTRY DATA IN THE

NETHERLANDS, Royal Netherlands Meteorological Inst., De Bilt. For primary bibliographic entry see Field 5A. W88-08950

5C. Effects Of Pollution

RECURRENT AND PERSISTENT BROWN TIDE BLOOMS PERTURB COASTAL MARINE ECOSYSTEM. State Univ. of New York at Stony Brook. Marine Sciences Research Center. For primary bibliographic entry see Field 2L. W88-08013

NEKTON ASSEMBLAGES OF THREE TRIBUTARIES TO THE CALCASIEU ESTUARY, LOUISIANA, McNeese State Univ., Lake Charles, L.A. Dept. of Biological and Environmental Sciences. For primary bibliographic entry see Field 2L. W88-08018

OCCURRENCE AND DISTRIBUTION OF SHORTNOSE STURGEON, ACIPENSER BRE-VIROSTRUM, IN THE UPPER TIDAL DELA-WARE RIVER,

Southeastern Louisiana Univ., Hammond. Dept. of Biological Sciences. Biological Sciences.
R. W. Hastings, J. C. O'Herron, K. Schick, and M.

R. W. Flastings, 7.

A. Lazzari.

Estuaries ESTUDO, Vol. 10, No. 4, p 337-341,

December 1987. 3 fig, 1 tab, 14 ref. U.S. Army

Corps of Engineers Contracts DACW-61-81-C
0138 and DACW-61-84-C-0007.

Descriptors: *Sturgeon, *Fish populations, *Water quality, *Shortnose sturgeon, Tidal rivers, Acipenser brevirostrum, Seasonal distribution, Delaware River, Water pollution effects, Spawning, New Jersey, Pennsylvania.

Sampling in the upper tidal Delaware River between Trenton, N.J. and Philadelphia, Pa., from July 1981 through December 1984 demonstrated the existence of a significant population of shortnose sturgeon. The sturgeon aggregate in the river channel during daylight hours, especially in the area between Trenton and Florence, N.J. (river km area between 1renton and Florence, N.J. (tiver km 211.8 to 198.8). Occurrence in the river down-stream of Florence appears to be restricted by poor water quality during summer months. Sturgeon were present in the study area throughout the year, but largest numbers were collected from May through November. No spawning was observed during this study but presence of soles with sall during this study, but presence of males with milt suggests that spawning possibly occurs in the Trenton area. Preliminary population estimates indicate an adult population of approximately 6,000-14,000 shortnose sturgeon occupying the upper tidal Delaware River. (Author's abstract) W88-08019

EFFECTS OF TRIBUTYLTIN ON ACTIVITY AND BURROWING BEHAVIOR OF THE FID-DLER CRAB, UCA PUGILATOR, Rutgers - The State Univ., Newark, NJ. Dept. of Biological Sciences.
J. S. Weis, and J. Perlmutter.
Estuaries ESTUDO, Vol. 10, No. 4, p 342-346,

December 1987. 1 fig, 2 tab, 25 ref.

Descriptors: *Pesticides, *Tributyltin, *Water pol-lution effects, *Organotin compounds, *Toxicity, *Crabs, *Fiddler crab, *Uca pugilator, *Animal behavior, Antifouling paints, Organic compounds.

Fiddler crabs, Uca pugilator, collected from the field showed no avoidance to burrowing in 1 microgram/g tributyltin (TBT)-contaminated sand held in laboratory trays. Treatment with levels of TBT as low as 0.5 microgram/1 for 1-3 wk resulted in an acceleration of the righting reflex in females, indicative of hyperactivity. Crabs of both sexes exhibited a reduction in burrowing activity, as measured by the number of borrows dug at 15 and 60 min after release into trays containing sand, and by the number of crabs within burrows at those times. The reduction in burrowing activity was not times. The reduction in burrowing activity was not dose-dependent at concentrations of 0.5 to 50 micrograms/l, and was unchanged between 1-3 wk of exposure. Since fiddler crabs are dependent on burrows for many aspects of their lives, the reduc-tion in burrowing behavior, should it occur in nature, would have serious consequences for the species (Author's abstract)

SOIL CHANGES CAUSED BY MUNICIPAL WASTEWATER APPLICATIONS IN EASTERN SOUTH DAKOTA,

South Dakota State Univ., Brookings. Dept. of Plant Science. For primary bibliographic entry see Field 5E. W88-08032

TEMPERATURE AND THE PRODUCTIVITY-LIGHT RELATIONSHIP, Louisiana State Univ., Baton Rouge. Dept. of Civil eering.

S. D. Field, and S. W. Effler.
Water Resources Bulletin WARBAQ, Vol. 24, No.
2, p 325-328, April 1988. 3 fig. 2 tab, 20 ref.

Descriptors: "Water temperature, "Limnology, "Primary productivity, "Light quality, "Phyto-plankton, "Eutrophication, Biomass, Model stud-ies, Onondaga Lake, Statistical methods, Mathe-matical studies, Algae, New York, Chlorophyta.

Seventy-three in situ primary productivity experiments over a six-month period in hypereutrophic Conondaga Lake near Syracuse, New York, demonstrated variations in the light saturation parameter, I sub p, which in part describes the interaction between productivity and light. Substantial variations in I sub p, were observed (coefficient of between productivity and light. Substantial variations in I sub p were observed (coefficient of variation = 60 percent). Variations in I sub p were significantly correlated (greater than 99 percent confidence level) with temperature (deg C). An Arrhenius-type relationship (I sub p = 1.312 x. 1.088 to the (T-20) power) accounted for approximately 37 percent of the variation in I sub p and may be appropriate for other systems dominated by green algae. (Author's abstract)

W88-08039

EXPORT OF MIREX FROM LAKE ONTARIO TO THE ST. LAWRENCE ESTUARY, National Water Research Inst., Burlington (Ontar-io). Lakes Research Branch. For primary bibliographic entry see Field 5B. W88-08067

PALEOLIMNOLOGICAL EVIDENCE OF RECENT ACIDIFICATION IN TWO SUDBURY (CANADA) LAKES,

Trent Univ., Peterborough (Ontario). Trent Aquatic Research Centre. For primary bibliographic entry see Field 5B. W88-08068

CADMIUM SULFATE APPLICATION TO SLUDGE-AMENDED SOILS: I. EFFECT ON YIELD AND CADMIUM AVAILABILITY TO

Arkansas Univ., Marianna. Eastern Arkansas Soil

Effects Of Pollution—Group 5C

Testing and Research Lab. R. J. Mahler, J. A. Ryan, and T. Reed. The Science of the Total Environment STENDL, Vol. 67, No. 2/3, p 117-131, December 1987. 1 fig. 12 tab. 27 ref.

Descriptors: *Path of pollutants, *Land applica-tion, *Cadmium sulfate, *Crop yield, *Water pollu-tion effects, *Sludge disposal, *Playforgen ion con-centration, *Heavy metals, *Bioaccumulation, Soil amendments, Sludge disposal, Plant physiology, Swiss chard, Corn, Plants.

Swiss chard, Corn, Plants.

Twelve paired soils (only one of each pair having a history of sludge application) with pH values ranging from 3.9 to 7.4 were amended with CdSO4 in a growth chamber experiment. Three crops of Swiss chard (Beta vulgaris var. cicla) and one crop of corn (Zea mays) were sequentially grown for 5 weeks in pot cultures containing the treated soils. After the corn was harvested, soil pH was increased by the addition of 1% CaCO3 and the soil was allowed to incubate for 6 weeks prior to planting another corn and Swiss chard crop. Increasing Cd additions to the soils, whether as CdSO4 or in sewage sludge, resulted in increased Cd uptake by the plants, with the greatest accumulation of Cd by those plants grown on the acid soils. Liming the soils resulted in a decrease of Cd uptake by the two test crops. Regardless of soil pH, corn plants accumulated significantly higher concentrations of Cd than the Swiss chard plants. Results indicated that the added Cd was less available in the soils which had previously received sludge. In those pairs of soils which had previously received sludge was lower; thus, the added Cd would be expected to be more available. A comparison of the soils to which no CdSO4 had been added indicated that the Cd originating from sludge was still available for plant uptake. The data indicate the need to consider previous sludge application (cumulative Cd additions) in evaluating potential Cd accumulation by plants from current (annual) Cd additions. (Author's abstract)

LIMNOLOGICAL STUDIES ON THE NOZHA HYDRODROME, EGYPT, WITH SPECIAL REFERENCE TO THE PROBLEMS OF POL-

LUTION, Alexandria Univ. (Egypt). Dept. of Oceanography. For primary bibliographic entry see Field 5B. W88-08070

TOXICITY OF MANGANESE AND ITS IMPACT ON SOME ASPECTS OF CARBOHY-DRATE METABOLISM OF A FRESHWATER TELEOST, COLISA FASCIATUS,

Gorakhpur Univ. (India). Dept. of Zoology. K. Nath, and N. Kumar. The Science of the Total Environment STENDL, Vol. 67, No. 2/3, p 257-262, December 1987. 2 tab,

Descriptors: *Manganese, *Carbohydrate metabolism, *Fish physiology, *Perch, *Bioassay, *Toxicity, *Water pollution effects, *Heavy metals, Subity, *Water pollution effects, *Heavy metals, Sub-lethal effects, Population exposure, Glycogen, Glu-cose, Metabolism, Temporal distribution.

The impact of manganese on the static bioassay using the freshwater perch Colisa fascitus was assessed. LC50 at 96 h was found to be 3230 mg/L or 0.0191 moles/L. The effect of a sub-lethal concentration of 2584 ppm on the liver glycogen and blood glucose was investigated at 3, 6, 12, 24, 48, blood glucose was investigated at 3, 6, 12, 24, 48, 72 and 96 h. Liver glycogen increased significantly at 3 h and thereafter it started declining and decreased significantly from 24 h up to 96 h. The blood glucose level registered a significant decrease at 3 h but subsequently started increasing and a significant and well-marked increase was recorded at 48, 72 and 96 h. (Author's abstract) W88-08071

EFFECTS OF NUTRIENT (N, P, C,) ENRICH-MENT UPON PERIPHYTON STANDING CROP, SPECIES COMPOSITION AND PRI-MARY PRODUCTION IN AN OLIGOTRO-

West Chester Univ. of Pennsylvania. Dept. of Biology. For primary bibliographic entry see Field 2H. W88-08075

CADMIUM TOXICITY TO THE FRESHWATER AMPHIPOD GAMMARUS PULEX (L.) DURING THE MOULT CYCLE,

DURING THE MOULT CYCLE, University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology. C. P. McCahon, and D. Pascoe. Freshwater Biology FWBLAB, Vol. 19, No. 2, p 197-203, April 1988. 3 fig, 2 tab, 24 ref.

Descriptors: *Cadmium, *Molting, *Amphipods, *Gammarus, *Water pollution effects, *Toxicity, *Heavy metals, *Population exposure, Animal physiology, Aquatic animals, Sensitivity, Calcium, Water quality standards.

The toxicity of cadmium to mature Gammarus pulex at different stages in the molt cycle is described. Immediate post-molt animals are significantly more sensitive than intermolt specimens at cadmium concentrations between 1.0 and 0.1 mg/L but not at 0.03 or 0.01 mg/Cd/L. At a calcium concentration of 40 mg/L, post-molt animals undergo recalcification within 7 days and thereafter there is little variation in their response to cadmium. External calcium concentrations of 40 and 115 mg/L do not affect cadmium toxicity but at 180 mg Cd/L the sensitivity of immediate post-molt specimens is significantly reduced. The results are discussed with regard to the protection of G. pulex by present water quality standards. (Author's abstract) stract) W88-08081

MODERN DIATOM ASSEMBLAGES IN CENTRAL MEXICO: THE ROLE OF WATER CHEMISTRY AND OTHER ENVIRONMENTAL FACTORS AS INDICATED BY TWINSPAN AND DECORANA, Stirling Univ. (Scotland). Dept. of Environmental

S. E. Metcalfe.

Freshwater Biology FWBLAB, Vol. 19, No. 2, p 217-233, April 1988. 5 fig, 5 tab, 17 ref, append.

Descriptors: *Data processing, *Statistics, *Lim-nology, *TWINSPAN, *Ecological effects, *DE-CORANA, *Diatoms, *Water pollution effects, *Population dynamics, *Model studies, *Water chemistry, Aquatic habitats, Sediments, Computer programs, Mexico.

Modern diatom samples, for which physical and chemical environmental conditions were recorded, were collected from forty-seven sites across Cen-tral Mexico. The results of the diatom counts were analyzed using the clustering program TWIN-SPAN and the ordination program DECORANA. SPAN and the ordination program DECORANA. Results from 'Laguna Zacapu and associated sites' showed that where water chemistry varies little between sample sites the effects of habitat are emphasized. This data set highlighted the problems of looking for modern analogs where anthropogenic disturbance is great. TWINSPAN results from the 'Other Sites' data set suggested possible changes in diatom assemblages with chemical composition. The DECORANA analyses, however, again seemed to emphasize habitat. In the context passion. In DECURANA analyses, Nowever, again seemed to emphasize habitat. In the context of this study, bottom sediment samples appeared to provide the most useful picture of 'average' conditions and to be the best source of analogs for the interpretation of fossil assemblages. (Author's abstract)

EFFECTS OF LOW PH AND HUMUS ON THE SURVIVORSHIP, GROWTH AND FEEDING OF GAMMARUS PULEX (L.) (AMPHIPODA), OF GAMMAROS FOLEA (L.) (AMPHIPODA', Lund Univ. (Sweden). Dept. of Ecology. A. Hargeby, and R. C. Petersen. Freshwater Biology FWBLAB, Vol. 19, No. 2, p 235-247, April 1988. 5 fig. 6 tab, 63 ref.

Descriptors: *Acidity, *Acid rain, *Survival, *Amphipods, *Gammarus, *Water pollution effects, *Toxicity, *Food habits, *Population expo-

sure, *Growth, Metal complexs, Aquatic animals, Decomposing organic matter, Animal physiology, Aquatic habitats, Acidic water, Growth.

The toxicity to the freshwater amphipod Gammarus pulex (L.) of soft water (pH 6.0) with three concentrations of XAD-extracted aquatic humus was tested in the laboratory. Exposure to pH 6.0 water without humus added resulted in 92% mortality after 3 weeks. Humus, added at concentratality after 3 weeks. Humus, added at concentra-tions of 7 and 20 g C/cu m, decreased the mortali-ity to 80% and 64% in the same period. Surviving animals kept at pH 6.0 had a lower growth rate, lower food conversion efficiency and higher body water content than animals kept at pH 7.3. Humus had no significant effects on growth, food conver-sion or body composition of G. pulex kept at pH 6.0. However, there was a tendency for growth and food conversion to increase and for body 6.D. However, there was a tendency for growth and food conversion to increase, and for body water content to decrease with increased humus concentration. The effects of humus on growth and food conversion of G. pulex observed in this study do not support the contention that humus acts as a free coupler to lower metabolic efficiency. On the contrary, humus tended to benefit food conversion. It is suggested that low concentrations. conversion. It is suggested that low concentrations of humus can be directly beneficial to organisms in acidified water in ways other than by complexing toxic metals. (Author's abstract) W88-08083

IMPORTANCE OF HYDROGEN IONS AND ALUMINUM IN REGULATING THE STRUC-TURE AND FUNCTION OF STREAM ECOSYS-TEMS: AN EXPERIMENTAL TEST,

Ontario Ministry of the Environment, Dorchester. Dorset Research Center.

R. J. Hall, C. T. Driscoll, and G. E. Likens. Freshwater Biology FWBLAB, Vol. 18, No. 1, p 17-43, August 1987. 10 fig, 3 tab, 133 ref. Cornell EPA Cooperative Agreement

Descriptors: "Hydrogen ion concentration, "Aluminum, "Path of pollutants, "Snowmelt, "Acidic water pollution effects, "Stream pollution, Streams, Acidic water, Snowmelt, Water pollution, Chemical properties, Biological properties, Insects, Behavior, New Hampshire, invertebrates.

Experiments simulating spring acidic snowmelt episodes were conducted to determine the effects of short-term inputs of H(+) and Al on the chemistry and biology of a poorly buffered mountain stream. HCl and AlCl3 were added in separate experiments to first- to third-order reaches of a Hampshire stream. Cation exchange and +) dissolution reactions neutralized experi-Al(n+) dissolution reactions neutralized experimentally added H(+), whereas groundwater dilution was insignificant. Mobilized Ca(2+), Mg(2+) and Al(n+) concentrations progressively increased from third-to first-order reaches during HCL additions. Mobilization of Ca(2+) and Mg(2+) was greater during AlCl3 than HCl additions. Total phosphorus was mobilized from stream sediments during both HCl and AlCl3 addition. Dissolved organic carbon (DOC) decreased during AlCl3 Al(n+) dis during both HCI and AlCI3 addition. Dissolved organic carbon (DOC) decreased during AlCI3 addition in the second-order but not in the third-order reach. DOC concentration decreased during HCI addition only when Al(n+) mobilized from the stream bottom was >0.28 mg Al/liter. Production of foam at the water surface during AlCI3 addition to a second-order and HCI addition to a addition to a second-order and HCl addition to a first-order reach indicated a reduction in surface tension of the streamwater and may be related to complexation reactions between Al and DOC at low pH (4-5). Mayfly nymphs and blackfly and chironomid larvae drifted at greater rates from HCl- and AlCl3-treated sections of first- and second-order streams than from corresponding reference areas. When stream pH was lowered to 5.25-5.5 by HCl alone (15 micrograms monomeric inorganic Al/liter), the behavior of aquatic invertebrates did not change, but pH reduced to the same range during Al additions (280 micrograms Al/liter) did affect it. Therefore, fluctuating aluminum concentrations in low-order streams at a pH range concentrations in low-order streams at a pH range of 4.5-5.5 may alter the biology and geochemistry of poorly buffered waters. (Author's abstract)

Group 5C-Effects Of Pollution

EFFECTS OF CHRONIC CHLORINE EXPO-SURE ON LITTER PROCESSING IN OUT-DOOR EXPERIMENTAL STREAMS, Minnesota Univ., St. Paul. Dept. of Forest Re-

R. M. Newman, J. A. Perry, E. Tam, and R. L. Crawford.

Crawford.
Freshwater Biology FWBLAB, Vol. 18, No. 3, p
415-428, December 1987. 5 fig. 2 tab, 39 ref.
USEPA Cooperative Contract CR 812468-01-1.
University of Minnesota College of Forestry and
Agricultural Experiment Station Project 42-025.

Descriptors: "Wastewater disposal, "Litter, "Water pollution effects, "Wastewater disposal, "Chlorine, "Decomposing organic matter, "Microbiological studies, Organic matter, Detritus, Decomposition, Microbial degradation, Degradation, Residual chlorine, Streams, Amphipods, Pond-

The effects of chlorine on the processing of latter from Potamogeton crispus were examined using six outdoor experimental streams. Downstream portions of two streams were dosed at approximately 10 micrograms (ug)/1 Total Residual Chlorine, one stream at 64 ug/l, and one stream at 230 ug/l. Two control streams were not dosed; upstream riffles of control streams were not dosed; upstream riffles of each stream served as instream controls. Two 35-day litter breakdown (percent ashfree dry weight remaining) experiments indicated significantly lower decay rates in the high dose riffle. No other concentration of chlorine significantly affected decay rate. A third experiment, conducted in medium and high dose streams, indicated that high dose chlorine exposure reduced litter decomposi-tion rates significantly, and reduced microbial coltion rates significantly, and reduced microbial col-onization, microbial electron transport system ac-tivity, and microbial litter decomposition after 4 days but not after 11 days of exposure. The number of amphipods which act as litter shredders, colo-nizing litter bags was also reduced significantly with high chlorine dose. A fourth experiment, after dosing was terminated, provided direct evidence that amphipods were important in facilitating litter decomposition; litter bags stocked with amphipods had significantly higher decomposition rates than decomposition; inter bags stocked with amphipods had significantly higher decomposition rates than bags which excluded shredders. Overall results indicate that the high dose (about 230 ug/l Total Residual Chlorine) of chlorine reduced litter processing rates partly by reducing initial microbial conditioning, but primarily by reducing the colonization of amphipods. (Author's abstract)

RELATION BETWEEN WAVE EXPOSURE AND DISTRIBUTION OF EMERGENT VEGE-TATION IN A EUTROPHIC LAKE, Lund Univ. (Sweden). Dept. of Ecology. For primary bibliographic entry see Field 2H. W88-08114

COASTAL WATER QUALITY AND ITS EFFECT ON BEACH EROSION: A CASE

Howard Univ., Washington, DC. M. M. Varma, and J. Alfaro. Journal of Environmental Systems, Vol. 17, No. 3, p 177-185, 1987-88. 2 fig, 9 ref.

Descriptors: *Reefs, *Wave action, *Coastal waters, *Water quality, *Water pollution effects, *Erosion, *Beach erosion, Barbados, Groins, Wastewater disposal, Corals.

aches in Barbados are eroding at an average rate of 6 percent per year. Comparatively, the erosion on the west coast is less than the south coast because groins and other protective measures are successfully maintaining the integrity of the beachsuccessfully maintaining the integrity of the beaches. Untreated and/or partially-treated wastewater
discharged into the coastal region has deteriorated
the onshore water quality. This has resulted in
decay of coral reefs, thus permitting greater wave
energy to hit the offshore structures and leading to
shore erosion and damage to buildings on the
shore. (Author's abstract)
W88-08141

MODELS FOR THE DISSOLUTION OF CAR-BONATE ROCKS AND THE C13/C12 EVOLU-

TION OF CARBONATE GROUND WATERS (MODELLE DER KALK-AUFLOESUNG UND C13/C12-ENTWICKLUNG VON KARBONAT-

C13/C12-ENTWICKLUNG VON KARBUNAI-GRUNDWAESSERN),
Gesellschaft füer Strahlen- und Umweltforschung
m.b.H., Neuherberg bei Munich (Germany, F.R.).
Inst. füer Radiohydrometrie.
K. W. Schaefer, and E. Usdowski.
Zeitschrift füer Wasser- und Abwasser-Forschung
ZWABAQ, Vol. 20, No. 3, p 69-81, June 1987. 15

Descriptors: *Weathering, *Acid rain, *Ground-water, *Carbonate rocks, *Carbonates, *Model water, *Carbonate rocks, *Carbonates, *Model studies, *Geochemistry, Geohydrology, Hydrolog-ic models, Chemical properties, Carbon dioxide, Sulfur compounds, Air pollution, Recharge, Math-ematical models, Isotope studies.

The subsurface dissolution of carbonate rocks is essentially controlled by dissolved biogenic carbon dioxide, and occurs in hydrogeochemical systems which stand between two limiting cases. In industrial areas an additional dissolution by dissolved sulfur oxides from atmospheric pollution may occur. A model consideration of these processes requires date on the composition of groundwater occur. A model consideration of these processes requires data on the composition of groundwater with respect to the major components as well as data on the stable carbon isotopes of the dissolved carbonate, the carbonate rocks, and the soil carbon dioxide in the recharge area. It is further necessary dioxide in the recurange area. It is furture necessary to determine the quantities of the dissolved sulfate of geogenic and anthropogenic origin. The formal treatment of quantitative model considerations for various hydrogeochemical situations is deduced using the system CaCO3-CO2-SO3-H2O. (Author's abstract) W88-08145

TOXIC SITUATION OF LEPIDIUM SATIVUM IN THE WUPPER-RIVER: A SUPPLEMENTAL METHOD OF WATER QUALITY SURVEIL-LANCE (DIE TOXIKOLOGISCHE SITUATION DER WUPPER GEGENUEBER DER GAR-TENKRESSE (LEPIDIUM SATIVUM): EINE ERGAENZENDE METHODE DER GEWAES-SERGUETEUEBERWACHUNG),

For primary bibliographic entry see Field 5A. W88-08148

SPLIT POND - ONE MEANS OF GETTING COMPARABLE MODEL ECOSYSTEMS, Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Botanik, Lehrgebeit Systematik und Oe-

kophysiologie. F.J. Zieris, D. Feind, and W. Huber.

Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 21, No. 1, p 7-10, February 1988. 2 fig, 3 tab, 13 ref.

Descriptors: *Water pollution, *Ponds, *Physical models, *Model studies, Artificial aquatic ecosystems, Split pond, Ecosystems, Legislation.

The use of artificial aquatic ecosystems to assess the risks posed by chemical substances is being considered in the drawing up of Stage Two of the German legislation on chemicals as well as in similar legislation by the OECD. For such methods of risk assessment and in research using artificial ecosystems in general, it is important to be able cial ecosystems in general, it is important to be able to distinguish between changes induced by the experiment and natural changes in the ecosystem. In order to make this possible, a model ecosystem was set up which could be divided into 3 compartments after a stabilization phase of 2 years. The effect of the division and the development of the compartments were monitored over a period of 18 months. During this time the development of the compartments was very similar. It is concluded that the split pond is well suited for ecotoxicological research which needs comparable ecosystems.

DOWNCORE SULPHUR ISOTOPE RATIOS AND DIATOM INFERRED PH IN AN ARTIFI-CIALLY ACIDIFIED CANADIAN SHIELD

Brock Univ., St. Catharines (Ontario). Dept. of

Biological Sciences M. Dickman, H. G. Thode, S. Rao, and R. Anderson. Environmental Pollution EPEBD7, Vol. 49, No. 4, p 265-288, 1988. 26 fig, 2 tab, 45 ref.

Descriptors: *Sulfur isotopes, *Acid rain effects, *Acidification, *Hydrogen ion concentration, *Diatoms, *Lakes, *Lake sediments, *Cores, Chrysophyta, Sulfur, Radioisotopes, Acidity, Stratigraphy, Pollen, Sulfuric, Lead radioisotopes, Cesium radioisotopes, Sediments, Bacteria, Sulfur bacteria, Bacterial physiology.

Three gravity cores were removed from Lake 223 in Ontario, eight years after ixperimental acidification of the lake with sulfuric acid. Cores were examined for diatoms and pollen stratigraphy, downcore sulfur isotope ratios, and downcore changes in sulfur-reducing bacterial densities. Sediment core chronologies were based on Pb-210 and Cs-137 data and the Ambrosia pollen rise. The diatom-inferred pH at the time of the Ambrosia rise (c. 1890) was determined to be 6.8-7.0. At a sediment depth of 3 cm, the value was 6.7. Diatom-inferred pH then began to decline to the current observed range of 5.3-5.5. An increase in abundance of two benthic alkalophilic diatoms at a depth of 1 cm was ascribed to an increase in hypolimmetic alkalinity following artificial acidification; this is the first time lake acidification has been linked to an increase in benthic alkalophilic cation; this is the tirst time lake accumication has been linked to an increase in benthic alkalophilic diatoms associated with hyploimnetic alkalinity production following sulfate reduction. Sulfur in the anaerobic sediment layers (0-1.5 cm) was isotopically lighter than sulfur in the deeper layers, due to sulfur isotope fractionation resulting from the bacterial reduction of sulfate to H2S in the anaerobacterial reduction of suitate to H2S in the abaero-bic portion of the water column. A black, FeS-rich layer in the uppermost 1.5 cm of sediment was associated with an increase in the abundance of sulfate-reducing bacteria. (Doria-PTT). W88-08200

VERIFICATION OF A NUMERICAL BEACH WATER QUALITY MODEL,

Gore and Storrie Ltd., Toronto (Ontario). For primary bibliographic entry see Field 5A.

ECOTOXICOLOGY: A FRAMEWORK FOR IN-VESTIGATIONS OF HAZARDOUS CHEMI-CALS IN THE ENVIRONMENT,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.

D. W. Connell. AMBIO AMBOCX, Vol. 16, No. 1, p 47-50, 1987. 3 fig. 2 tab, 12 ref.

Descriptors: *Hazardous chemicals, *Pollutants, *Fate of pollutants, *Toxicity, *Environmental effects, *Ecotoxicology, *Data acquisition, Mini-

hazardous chemicals have, in recent years, become a major focus for the environmental management activities of the OECD (Organization for Economic Cooperation and Development). This has culminated in recommendations for a set of physical, chemical, and biological tests and an evaluation procedure which will form the basis for predicting the possible environmental effects of new chemicals. The ecotoxicological assessment of a chemical depends on two basic types of information: (1) the environmental concentrations of the substance resulting from discharge and distribution, and (2) the toxicological properties of the chemical given a certain concentration and certain location. To enable these two basic items of information to be evaluated by the OECD procedure requires the production of a set of basic data on each chemical. This is referred to as the Minimum Premarket Data set and includes information on: each chemical. This is referred to as the Minimum Premarket Data set and includes information on: chemical identification, production, use and disposal, analytical methods, physical/chemical proper-ties, human toxicitry, mutagenicity, ecotoxicity and degradation/accumulation. The evaluation procedure attempts to trace the fate of a chemical from discharge and dispersal to subsequent effects on biota. It provides a conceptual framework for

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the development of a new scientific discipline de-scribed as ecotoxicology. (Sand-PTT) W88-08222

COASTAL EUTROPHICATION IN SWEDEN: REDUCING NITROGEN IN LAND RUNOFF, Halland County Administrative Board, Halmstad ary bibliographic entry see Field 5G.

For prima W88-08227

EFFECTS OF TECHNICAL AND COMMER-CIAL GRADE PHOSPHAMIDON ON THE CARBOHYDRATE METABOLISM IN SELECT-ED TISSUES OF PENAEID PRAWN, META-PENAEUS MONOCEROS (FABRICIUS),

PENARUS MONUCEROS (FABRICIUS), Sri Venkateswara Univ., Tirupati (India). Dept. of Marine Zoology. M. Srinivasulu-Reddy, and K. V. Ramana-Rao. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 3, p 389-395, March 1988. 2 tab, 22 ref.

Descriptors: *Phosphamidon, *Organophosph-phorus pesticides, *Insecticides, *Water pollution effects, *Tissue analysis, *Pesticide toxicity, *Crus-taceans, *Shrimp, *Carbohydrates, *Metabolism, *Path of pollutants, Penaeid prawn, Marine pollu-tion, Estuarine pollution, Bioaccumulation, Die-tary exposure, Induced toxicity, Organophosphor-ous insecticides, India.

Changes in carbohydrate metabolism in selected tissues of the prawn, Metapenaeus monceros, were studied during induced toxicity by technical and commercial grade phosphamidon, an organophosphorous insecticide. Penaeid prawn were collected from the Buckingham canal near Kavali seacoast, Andhra Pradesh, India. This study concludes that either commercial or technical grade phosphamidon decreases oxidative metabolism in the tissues of the prawn which consequently suifches to an on decreases oxidative metabolism in the tissues of the prawn which consequently switches to an aerobic pathways as an adaptive measure to combat the induced pesticide toxicity and also to survive through the phosphamidon polluted habitats. (Miller-PTT)

DIFFERENTIAL COURTSHIP ACTIVITY OF COMPETING GUPPY MALES (POECILIA RETICULATA PETERS; PISCES: POECILIDAE) AS AN INDICATOR FOR LOW CONCENTRATIONS OF AQUATIC POLLUTANTS, Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenbiologie.

For primary bibliographic entry see Field 5A. W88-08248

CADMIUM AND ZINC CONCENTRATIONS IN THE POTABLE WATER OF THE EASTERN PROVINCE OF SAUDI ARABIA, King Faisal Univ., Damman (Saudi Arabia). Coll. of Medicine and Medical Sciences.

For primary bibliographic entry see Field 5F. W88-08250

RESISTANCE OF TEMPERATURE TOLER-ANCE ABILITY OF GREEN SUNFISH TO CADMIUM EXPOSURE, North Texas State Univ., Denton. Dept. of Biolog-

ical Sciences.

ical sciences.

R. Carrier, and T. L. Beitinger.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 4, p 475-480, April 1988. 1 tab, 15 ref.

Descriptors: *Cadmium, *Heavy metals, *Temperature tolerance, *Fish, *Temperature effects, *Water pollution effects, *Population exposure, *Sunfish, Thermal pollution, Aquatic pollution, Trace metals, Resistance, Tolerance, Detoxification, Statistical methods.

The effects of cadmium on the temperature toler-ance of green Sunfish, Lepomis cyanellus, were studied. Approximately 100 fish were placed in each of four aquaria (control and three cadmium

concentrations). Fish were removed from each aquarium for critical thermal maximum (CTM) aquarium for critical thermal maximum (CTM) measurements after 1, 5 and 10 days of cadmium exposure. Prior to CTM trials, experimental fish were exposed to cadmium in the following concentrations: 2.76, 4.22, and 5.17 mg/L. Little variation was found in the CTMs of controls; coefficients of variation for days 1, 5, and 10 were all less than 2%. Given the tightness of the control data, any cadmium-induced change in CTM would be detected as statistically significant. Neither cadmium concentration nor exposure time had a significant effect on CTM in this species. (Miller-PTT) W88-08251

INDUCTION OF MICRONUCLEI AND NU-CLEAR ABNORMALITIES IN THE ERYTHRO-CYTES OF MUDMINNOWS (UMBRA LIMI) AND BROWN BULLHEADS (ICTALURUS NE-BULOSUS),

Trent Univ., Peterborough (Ontario). Environ-mental and Resource Studies Program. For primary bibliographic entry see Field 5A. W88-08252

INTERMITTENT FLOW SYSTEMS FOR POP-ULATION TOXICITY STUDIES DEMON-STRATED WITH DAPHNIA AND COPPER, Ministry of Transport and Public Works, Lelystad (Netherlands). For primary bibliographic entry see Field 5A. W88-08253

SUBLETHAL EFFECTS OF COPPER AND MERCURY ON SOME BIOCHEMICAL CONSTITUENTS OF THE ESTUARINE CLAM VILLORITA CYPRINOIDES VAR. COCHINENSIS (HANLEY),
Cochin Univ. (India). Dept. of Marine Sciences. For primary bibliographic entry see Field 5A. W88-08254

TOXICITY OF METHYLENEBISTHIOCYAN-ATE (MBT) TO SEVERAL FRESHWATER OR-GANISMS,

GANISMS, Ministry of Transport and Public Works, Lelystad (Netherlands). Lab. for Ecotoxicology.

J. L. Maas-Diepeveen, and C. J. Vanl.eeuwen.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 4, p 517-524, April 1988. 4 fig. 3 tab, 16 ref.

Descriptors: *Methylenebisthiocyanate, *MBT, *Toxicity studies, *Freshwater organisms, *Water pollution effects, *Organic compounds, *Pesticides, *Aquatic life, *Population studies, Path of pollutants, Chemical pollution, Fish populations, Plant populations, Aquatic populations, Organosulfur compounds, Aquatic pollution, Microbiocide, The Netherlands.

The organo-sulfur compound methylenebisthio-cyanate (MBT) has successfully been used as a preservative in latex emulsions, starches and gums, cyanate (MB1) has successfully been used as a preservative in latex emulsions, starches and gums, acrylic fibers, coatings, curing salts for hide and leather and cutting oil systems. The greatest application of MBT is for cooling water systems and paper mill systems as an effective inhibitor of algae, fungi and bacteria, in particular the sulfate reducing anaerobic Desulfovibrio sp. Low concentrations of 3-4 mg per 1 have proved to be successful. For its use as a microbiocide in water systems, MBT is usually formulated with dispersants (on basis of alkylglycols) to make it penetrable to invade the stime layers of algae and bacteria. Because MBT is not substantive to cellulose or other particulate matter or to debris in systems, it remains in the water. However, MBT hydrolyzes rapidly above pH 8.0. The half-conversion time at pH 8.0 is about 4.5 hours. No data are available on residues of MBT in the aquatic environment. Information on the toxicity of MBT, except for all its effects on bacteria and algae, is scarce. Therefore, research was carried out to evaluate its risk to aquatic life. (Author's abstract)

DIURNAL PATTERNS OF AMMONIUM AND UN-IONIZED AMMONIA IN STREAMS RE-

CEIVING SECONDARY TREATMENT EFFLU-

Iowa State Univ., Ames. Dept. of Botany For primary bibliographic entry see Field 5B. W88-08256

GROWTH INHIBITION OF BACILLUS SUBTI-LIS BY BASIC DYES, Gifu Univ. (Japan). Dept. of Chemistry. For primary bibliographic entry see Field 5D. W88-08257

CHRYSOPHYCEAN MICROFOSSILS PRO-VIDE NEW INSIGHT INTO THE RECENT HIS-TORY OF A NATURALLY ACIDIC LAKE (CONE POND, NEW HAMPSHITE), Queen's Univ., Kingston (Ontario). Dept. of Biol-

ogy. K. N. Gibson, J. P. Smol, and J. Ford. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 9, p 1584-1588, September 1987. 2 fig, 29 ref.

Descriptors: "Water pollution effects, "Acidic water, "Lakes, "Microfossils, "Acid rain, "Lake acidification, "Chrysophyya, "Sedimentology, "Lake sediments, Chrysophycan fossils, Chryso-phyte flora, Cone Pond, New Hampshire, Dia-toms, Paleolimnological studies, Geology, Flora,

Cone Pond, New Hampshire, is an acidic (pH=4.5) clearwater lake that is currently fishless. Historical records indicate declining fish populations between 1951 and 1966, but paleolimnological work using diatoms failed to find evidence for further recent acidification of this naturally acid further recent acidification of this naturally acid site. New paleolimnological studies used mallomonadacean chrysophytes to further understanding of Cone Pond's recent past. Stratigraphic analyses indicate recent striking changes in the chrysophyte flora of this lake, with Mallomonas hinonii, a species only common in recently acidified lakes, replacing M. crassisquama, a cosmopolitan species that dominated the flora over the preceding 8000 years. This recent change narallels the declines in that dominated the flora over the preceding 8000 years. This recent change parallels the declines in fish populations. Because chrysophytes often bloom in early spring and are known in other lakes to experience changes in community composition before those expressed by the diatom community. A possibility is that chrysophytes track transient excursions of lake water chemistry associated with early snowmelt conditions. In this scenario, chrysophytes would respond to a constitution of the products when the products were the products and the products are the products are the products are the products and the products are th early snowment conditions. In this scenario, chrysophytes would respond to a constellation of specific short-term chemical changes including, but not restricted to, pH. Such pH associated changes could include changes in concentrations, speciation or complexation of metals mobilized from the catchment or sediments, all of which are known to affect both chrysophytes and fish. (Author's abstract) W88-08258

PROCESSES AND CAUSES OF LAKE ACIDIFI-CATION DURING SPRING SNOWMELT IN THE WEST-CENTRAL ADIRONDACK MOUN-TAINS, NEW YORK,

Virginia Univ., Charlottesville. Dept. of Environtal Sciences

J. N. Galloway, G. R. Hendrey, C. L. Schofield,

N. E. Peters, and A. H. Johannes. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 9, p 1595-1602, September 1987. 5 fig., 38 ref.

Descriptors: "Water pollution effects, "Lakes, "Acidic water, "Lake acidification, "Hydrogen ion concentration, "Adirondack Mountains, "Acid rain, "Snowmelt, New York, Lakes, Spring acidifi-cation, Sulfur deposition, Nitrification, Soil studies.

The surface and outlets of two headwater lakes acidified during the 1978, 1979, and 1980 spring snowmelt periods. The decrease in pH was accompanied by an increase in nitrate whereas the other panies by an increase in minate wireless in outside strong acid ion, SO4(-2), remained relatively con-stant. Chemical mass-balance calculations, using data from the integrated Lake-Watershed Acidifi-cation Study, indicate that the peak in acidification

Group 5C-Effects Of Pollution

observed in the Adirondack Mountains in the spring is caused by (1) a dilution of base cations (Ca(+2), Mg(+2), Na(+), and K(+) and associated alkalinity by snowmelt, (2) an increase in NO3(-) concentration in the acidified portion of the lakes, and (3) the constant elevated concentration of SO4(2-). At Woods Lake, the NO3(-) that accumulations are supported by the spring of t SO4(2-). At Woods Lake, the NO3(-) that accumulated in the snowpack plus that deposited from the atmosphere during snowmelt was sufficient to account for the increased NO3(-) in and transported from the lake. At Panther Lake, an additional source of NO3(-) was needed and was believed to be contributed by nitrification in the upper soil. horizons. If atmospheric deposition of sulfur is reduced, low alkalinity systems like Woods and moderate-alkalinity systems like Panther will be less likely to develop strong acidity during spring acidification. (Author's abstract) W88-08259

PERIPHYTON RESPONSE TO A GASOLINE SPILL IN WOLF LODGE CREEK, IDAHO, Idaho Univ., Moscow. Dept. of Plant, Soil and

Entomological Sciences.
K. W. Pontasch, and M. A. Brusven.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 9, p 1669-1673, September 1987. 3 fig. 14 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Gasoline, *Epiphytes, *Gas spill, *Periphyton, *Biomass, *Petroluem hydrocarbons, *Hydrocarbons, "Stream pollution, Autotrophic index, Idaho, Wolf Lodge Creek, Autotrophs, Heterotrophs, Algae, Lentic ecosystem, Path of pollutants, Chlorophyll a.

A post-impact study on a 94438-L unleaded gaso-line spill into Wolf Lodge Creek in northern Idaho was undertaken to determine the temporal and was undertaken to deiermine the temporal and spatial response of periphyton following the spill. Periphytic biomass and chlorophyll a concentrations were determined above and below the spill. Downstream areas were mechanically agitated to release substrate-trapped hydrocarbons 35 days after the spill. Periphyton samples were taken 26 days after the spill indicated that periphytic biomass, especially of the heterotrophs, was greater in the impacted than unimpacted areas; The Autotrophic Index was up to 30 times greater in the impacted reach. Two months after the spill and I month after stream cleaning, the Autotrophic month after stream cleaning, the Autotrophic Index was approximately the same in reference and impacted areas. (Author's abstract) W88-08262

ANALYSIS OF PLANKTONIC ROTIFER AS-SEMBLAGES FROM SUDBURY, ONTARIO, AREA LAKES OF VARYING CHEMICAL COMPOSITION,

COMPOSITION, Toronto Univ. (Ontario). Dept. of Botany. J. MacIssac, T. C. Hutchinson, and W. Keller. Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 44, No. 10, p 1692-1701, October 1987. 3 fig, 6 tab, 36 ref, append.

Descriptors: *Water pollution effects, *Acidic water, *Lakes, *Chemical composition, *Aquatic animals, *Plankton, *Rotifers, *Planktonic rotifers, *Acid rain, *Population studies, *Hydrogen ion concentration, *Manganese, *Aluminum, *Lake pollution, Ontario, Aquatic animals, Lake acidification, Plankton communities, Acidic lakes, Sudbury.

Planktonic rotifer samples were collected from 47 Sudbury, Ontario area lakes to determine factors influential to species distribution. The lakes ranged from highly acidic and metal contaminated to ciraroun migniy actions and metal concentrations. Median rotifer abundance was substantially higher in non-acid (pH)-5.2) than in acid (pH-5.2) lakes, although differences in species distribution were evident. Application of detrended correspondence analysis to rotifer species densities revealed broad analysis to rotter species densities revealed broad separation of communities from acid and non-acid lakes. Assemblages from acid lakes were highly similar in species composition and dominance while those from non-acid lakes were generally much more heterogeneous. It was hypothesized that planktonic rotifer communities converged in species composition as a consequence of the stress

of lake acidification in a pattern similar to that previously described for planktonic crustaceans. Among the best predictors of rotifer community composition were lake pH and the concentration of manganese and aluminum. (Author's abstract) W88-08263

IMPACT OF FENVALERATE ON ENCLOSED FRESHWATER PLANKTONIC COMMUNI-TIES AND ON IN SITU RATES OF FILTRA-TION OF ZOOPLANKTON,

Guelph Univ. (Ontario). Dept. of Environmental

Biology.

K. E. Day, N. K. Kaushik, and K. R. Solomon.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 10, p 1714-1728,

October 1987. 11 fig, 5 tab, 62 ref.

Descriptors: *Water pollution effects, *Agricultural chemicals, *Aquatic life, *Fenvalerate, *Planton, *In situ tests, *Pesticides, *Agricultural polution, *Filtration rates, *Zooplankton, Freshwater ecosystems, Toxicity studies, Phytoplankton, Population studies, Zooplankton, Kinetics.

The treatment of large volume (approximately 125 cubic meters) in situ lakes with fenvalerate at realistic field levels of agricultural contamination by drift or overspray (0.4-0. g fenvalerate per ha) resulted in the disruption of the structure and function of planktonic communities. The toxic effects ranged from short-term changes in the feeding behavior of several species of zooplankton (Daphnia spp. and Ceriodaphnia lacustris) at 0.05 micrograms fenvalerate per L to a drastic reduction in densities of most of the major groups of zooplankton at 0.1 micrograms fenvalerate per L tion in densities of most of the major groups of zooplankton at 0.1 micrograms fenvalerate per L for periods of up to 3 weeks following treatment. In addition, indirect effects of toxicity were observed (e.g. populations of rotifers and phytoplankton increased in enclosures after the removal of the large-bodied cladocerans). This is thought to be the result of a reduction in competition and grazing, respectively. The emulsifying agents used in the emulsifiable concentrate formulation of fenvalerate were not found to be toxic to zooplankton at concentrations expected after agricultural use. The half-life of fenvalerate in an enclosure treated with a nominal concentration of 0.1 microgram per L was estimated to be 4.1 days by first-order reaction kinetics. (Author's abstract)

NITROGEN TRANSFORMATIONS IN LAKE ONTARIO, National Water Research Inst., Burlington (Ontar-

For primary bibliographic entry see Field 2H. W88-08278

SPATIAL HETEROGENEITY OF NUTRIENTS AND ORGANIC MATTER IN LAKE ONTARIO, Inland Waters Directorate, Burlington (Ontario).

Water Quality Branch.
M. A. Neilson, and R. J. J. Stevens.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2192-2203,
December 1987. 6 fig. 5 tab, 45 ref.

Descriptors: *Limnology, *Eutrophication, *Lake Ontario, *Ammonia, *Phosphorus, *Nutrients, Stratification, Soluble reactive phosphorus, Phytoplankton, Thermal stratification, Epilimnion, Spatial distribution, Dissolved oxygen, Oxygen depletion, Particulate matter, Detritus, Organic matter.

During spring, Lake Ontario was vertically homo-During spring, Lake Ontario was vertically homogeneous except for the bottom 2 m where soluble reactive silica (SRS) and temperature (TEMP) were significantly (p < 0.05) elevated and dissolved oxygen was depleted. With stratification, soluble reactive phosphorus (SRP) and total filtered phosphorus, SRS, and nitrate-plus-nitrite were depleted in the epilimnion due to phytoplankton uptake. Total unfiltered phosphorus (TP) and ammonia (NH3) exhibited higher epilimnetic concentrations, the former being attributed to tribucentrations, the former being attributed to tribu-tary inputs which were maintained throughout the stratified period, even though inputs from Niagra

River served to dilute the epilimnion. Increased levels of TP, SRP, and SPS were also evident within the nepheloid layer. Horizontal distributions of TP and NH3 were governed by point-source input throughout the study period. Distributions of the soluble nutrients were governed by phytoplankton uptake in the spring, point/nonpoint inputs and upwelling in the summer, and differential breakdown of stratification in the fall. Spring distribution of particulate organic matter (POM) was strongly related to nutrient availability and water column stability, while phytoplankton species composition determined all POM distribution. Significantly higher (p < 0.05) POM levels, detrital content, and productivity were observed near-shore of the thermal bar. (Author's abstract)

STUDY OF THE UPTAKE BY DUCKWEED OF ALUMINUM, COPPER, AND LEAD FROM AQUEOUS SOLUTION,

Louisiana State Univ., Baton Rouge. For primary bibliographic entry see Field 5B. W88-08296

EFFECTS OF TRI- AND DICHLOROACETIC ACIDS ON THE OXYGEN CONSUMPTION OF THE DRAGONFLY NYMPH AESCHNA UM-

Massachusetts Univ., Amherst. Div. of Public

T. M. Dominguez, E. J. Calabrese, P. T. Kostecki, and R. A. Coler.

Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 3, p 251-271, April 1988. 2

Descriptors: *Aquatic life, *Insect, *Wastewater treatment, *Disinfection, *Chlorination, Chlorine, Trichloroacetic acid, Dichloroacetic acid, Dragon fly, Respiration, Oxygen requirements, Metabo-

The discovery of trihalomethanes in drinking water and the subsequent establishment of limits by the U.S. EPA aroused concern over the potential toxicological effects of elated by-products of water chlorination. Two recently characterized haloforms, trichloroacetic acid and dichloroacetic acid, have been reported to occur in drinking water at levels comparable to the trihalomethanes. As a consequence, this research examined the effects of these two chemicals on the oxygen consumption consequence, this research examined the effects of these two chemicals on the oxygen consumption rate of the dragonfly nymph Aeschna umbrosa. Nymphs were exposed for 8 hours to one of three haloform preparations (trichloroacetic acid, dichloroacetic acid, or combined) in a gravity feed flow-through testing apparatus. Four treatment levels (1, 10, 100 and 1000 microgram/l) and an unexposed control were tested. Results indicated a significant elevation in oxygen consumption of nymphs exposed to 100 and 1000 microgram/l of all three haloform preparations, but not at lower concentrations. (Author's abstract)

LEGIONNAIRES' DISEASE ASSOCIATED WITH A HOSPITAL WATER SYSTEM: A FIVE-YEAR PROGRESS REPORT ON CONTINU-OUS HYPERCHLORINATION,

Iowa Univ., Iowa City. Coll. of Medicine. For primary bibliographic entry see Field 5F. W88-08309

TOXICITY AND CHEMICAL COMPOSITION OF URBAN STORMWATER RUNOFF,

British Columbia Univ., Vancouver. Westwater Research Centre. K. J. Hall, and B. C. Anderson.

Canadian Journal of Civil Engineering CJCEB8, Vol. 15, No. 1, p 98-106, 1988. 5 fig, 3 tab, 39 ref.

Descriptors: *Water pollution effects, *Water pol-lution sources, *Storm runoff, *Urban runoff, *Water pollution, *Toxicity, *Land use, *Path of pollutants, *Trace metals, Daphnia, Crustaceans, Industrial wastes, Rainfall, Hydrogen ion concen-

Effects Of Pollution—Group 5C

tration, Suspended solids, Bioassay, Burnaby, British Columbia, Chemical composition.

The effects of land use on the chemical composition of urban stormwater runoff and its subsequent
acute toxicity to the aquatic invertebrate Daphnia
pulex were examined in the Brunette drainage
basin of Burnaby, British Columbia. Both land use
and interval between rainfall events influenced the
chemical composition and toxicity of the stormwater. The industrial and commercial land use sites
were the major source of those trace metals most
often considered toxic to aquatic invertebrates,
with runoff from the commercial sites proving
most frequently toxic to the test organism. Toxicity followed the sequence commercial > industrial
> residential > open space. A detailed study of a
single storm event indicated that while the 'firstflush' of the storm contributed to toxicity
-through the physical secouring of insoluble nollutsingle storm event indicated that while the 'first-flush' of the storm contributed to toxicity through the physical scouring of insoluble pollutants - some soluble pollutants, which were washed out of the watershed later in the storm event, also proved to be toxic. This finding has implications for the collection and treatment of stormwater runoff. Laboratory bioassays with synthetic stormwater composed of the trace metals Cu. Fe, Pb, and Zn at concentrations observed in field samples demonstrated that pH and suspended solids helped to regulate the toxicity of trace metals, and implicated the importance of these factors in natural stormwater toxicity. (Author's abstract) W88-08364

SOIL EROSION AND WATER TREATMENT

COSTS,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5F.
W88-08381

ACUTE TOXICITY OF TRIBUTYLTINS AND TRIBUTYLTIN LEACHATES FROM MARINE

TRIBUTYLTIN LEACHATES FROM MARINE ANTIBIOFOULING PAINTS, California Univ., Oakland. Naval Biological Lab. R. B. Laughlin, O. Linden, and H. E. Guard. Available from the National Technical Information Service, Springfield, VA 22161, as AD-A184 224. Price codes: A03 in paper copy, A01 in microfiche. Summary Report, 1982. 26 p, 2 fig., 16 ref. Office of Naval Research Project RR041-05.

Descriptors: *Water pollution effects, *Toxicity, *Tributyltin, *Water pollution sources, *Pesticides, *Paint, *Leachates, Amphipods, Gammarus ocean-icus, Orchestia traskiana.

Tributyltin compounds were shown to be slow-acting toxins causing acute toxicity on two amphipod species at concentrations as low as 10 g/l. Orchestia traskiana was exposed to bis (tributyltin) oxide (TBTO) or tributyltin fluoride (TBTF) as single compounds. Both compounds were acutely toxic in 10 days at concentrations of 10 g/L and above. Gammarus oceanicus were exposed to tributyltin leachates from panels painted with two different antifouling paint formulations. Following 48 hr immersion, aqueous tributyltin concentradifferent antifouling paint formulations. Following 48 hr immersion, aqueous tributyltin concentrations increased with increasing painted surface area, but one type of paint leached tributyltins about ten times faster than the other. Amphipod mortality in short-term tests was directly correlated with increases in painted surface area and leaching rates. Gammarus oceanicus was more sensitive than Orchestia traskiana based on measured tributyltins concentrations, with final leachate concentrations of 4.8 g/L causing total mortality in 5 days. The results of these experiments show that tributyltin compounds are very toxic to some nontributyltin compounds are very toxic to some non-target organisms. (Author's abstract) W88-08411

BIOENERGETIC EFFECTS OF BLACK ROCK HARBOR DREDGED MATERIAL ON THE PO-LYCHAETE NEPHTYS INCISA: A FIELD VER-IFICATION,

PIT Environmental Services, Seattle, WA.
D. M. Johns, and R. Gutjahr-Gobell.
Available from the National Technical Information
Service, Springfield, VA. 22161. Technical Report
No. D-88-3, March 1988. Final Report. 121 p, 19

fig, 26 tab, 47 ref, 2 append.

Descriptors: *Water pollution effects, *Black Rock Harbor, *Polychaetes, *Spoil banks, *Dredging, Field tests, Waste disposal, Suspended sediments, Water temperature, Metabolism, Worms, Biologi-

Biological energetics techniques were applied to Nephtys incisa, an infaunal polychaete dominant in the benthic community at the Central Long Island Sound disposal site. Comparisons were made between the effects of Black Rock Harbor (BRH) dredged material on the physiology and bioenergetics of juvenile Nephtys incita exposed in the laboratory and the same responses from individuals obtained in the field following the controlled disposal of BRH material. Exposure regimes used in the laboratory studies were similar to the exposure environments that had been predicted around the BRH disposal site. The laboratory data indicated that Nephtys incisa juveniles living in contaminant-free bedded sediment are physiologically affected when exposed to BRH suspended sediment. Physiological dysfunction observed as a result of laboratory exposure to BRH material included increased maintenance costs, reduced tissue growth, and lowered net growth efficiency. Physiological original dysunction observed as a result of labora-tory exposure to BRH material included increased maintenance costs, reduced tissue growth, and lowered net growth efficiency. Physiological changes were also noted in juvenile Nephtys incisa collected from the area of the disposal mound. Individual worms collected from stations within the perimeter of the disposal mound (400-m radius) exhibited significant changes in aerobic metabolism and ammonia excretion rates. There was a seasonal pattern in the bioenergetic responses coupled to seawater temperature. Laboratory derived expo-sure-response relationships indicated a response threshold of 30 to 50 mg/L suspended BRH sedi-ment. The field data for two stations indicate sig-nificant decreases in respiration rates relative to the REFS station, while the laboratory treatments re-sulted in significant increases in respiration rates with increasing concentrations of BRH sediment. (Lantz-PTT)

LONG TERM EFFECTS OF OIL ON MARINE BENTHIC COMMUNITIES IN ENCLOSURES. Norsk Inst. for Vannforskning, Oslo. Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-752501. Price codes: A10 in paper copy, A01 in microfiche. Norwegian Institute for Water Research Report No. 0-82007, December 1984. 251 p. Coordinated by T Bakbe.

Descriptors: *Water pollution effects, *Oil pollution, *Benthic environment, *Ecosystems, *Marine environment, Mollusks, Algae, Littoral environment,

The Rock Littoral Project exposed two enclosed littoral communities to two different chronic levels of diesel oil hydrocarbons. The levels originally aimed at were 200 and 50 micrograms/L total aimed at were 200 and 50 micrograms/L total hydrocarbons (dissolved and as droplets). The oil pollution phase was terminated on September 27, 1984. The communities are at present left undisturbed for investigation of short and long term recovery from the pollution impact. The recovery phase will last until the end of summer 1985. The effects of the oils on populations of Littorian littorea, Mytilus edulis, Balanus balanoides, Carcinus maenus, Aschophyllum nodosum, Streblosoma bairdi, and Monobryzoon limicola, are studied via population genetics, energy balance, molecular effects, feeding, and comparison studies. (See W88-0848) thru W88-08496) (Lantz-PTT)

COMMUNITY STRUCTURE, Norsk Inst. for Vannforskning, Oslo. T. Bokn, and F. Moy. IN: Long Term Effects of Oil on Marine Benthic

Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, December 1984. p 29-50, 22 fig, 2 tab, 2 ref.

Descriptors: *Environmental effects, *Oil pollu-tion, *Water pollution effects, *Benthos, Seasonal variation, Algae, Aquatic plants, Aquatic animals, Oil, Hydrocarbons, Monitoring, Fuel.

Estimating the numbers of motile animals and covering degree of sessile plants and animals in set areas in every test (High Oil (HO) and Low Oil (IO)) and control basin, is the goal of this project, thereby detecting any community changes and deviations within these basins. The composition of the littoral communities is characterized by monithe littoral communities is characterized by moni-toring percent cover of algae and sessile animals and number of motile animals, including (Fucus spiralis, Ascophyllum nodosum, F. vesiculosus, F. distichus, F. serratis, Laminaria digitata, Chondrus crispus, Cladophora rupestris, etc.). Six parallel quadrats from each step/bottom are investigated. The monitoring started in June 1982, and the peri-ods of sampling each year were: 15 January - 15 February, 15 March - 15 April, 15 May - 15 June, 15 July - 15 August, and 15 October - 15 Novem-ber. Thus, 12 characterizations of the community structure were performed during the period of oer. Inus, 12 characterizations of the community structure were performed during the period of investigation June 1982 - August 1984. The diesel oil exposed basins are: HO (about micrograms/L oil), LO (about 25 micrograms/L oil), Since September 27, 1984, the diesel oil exposure during 26 months has been terminated, and the project now looker. looks for community and population recovery. (See also W88-08482) (Lantz-PTT) W/88.08485

EFFECTS OF DIESEL OIL ON COMMERCIAL BENTHIC ALGAE IN NORWAY, Norsk Inst. for Vannforskning, Oslo.

T. Bokn.

IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, Decem-ber 1984. p 51-70, 8 fig, 2 tab, 21 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Benthic environment, *Fuel, *Algae, Descriptors: water pointion enests, "On pointion, "Benthic environment, "Fuel, "Algae, "Norway, Kelp, Aquatic plants, Oil, Littoral environment, Simulation analysis, Marine environment, Hydrocarbons, Plant growth, Benthos, Artificial

Length growth of the kelp Laminaria digitata and the fucoid Ascophyllum nodosum was studied to see if low continuous dosage of diesel oil has any effects on the growth during a two-year period of exposure. The project was part of a larger experiment of long term effects from low concentration of oil on a simulated litoral rock community kept in four 50 cu m concrete basins. During three years, implanted associations of four fucoids with their associated flora and fauna have established luxuriant and relatively stable communities. The basins are equipped with artificially made waves and tide. The duration of dosage will be from September 1982 to autumn 1984. The diesel oil is mixed to the inlet seawater as a water accomodat-September 1982 to autumn 1984. The diesel oil is mixed to the inlet seawater as a water accomodated fraction. The exposure level to the organisms averages about 100 micrograms/L total hydrocarbons in the highest diesel oil exposed basin and about 25 micrograms/L in the lowest. The other two basins act as controls. The work on A. nodosum started in June 1982. No significant growth difference was observed the first year. However, which 1981 and 1984 the new time of the week in during 1983 and 1984, the new tips of the year in both oil exposed basins were significantly shorter compared to the tips of the control. The growth of L. digitata from March to July 1983 was found to L. digutata from March to July 1950 was found to be of no significant difference. However, during spring 1984, both oil exposed basins have become significantly different from the controls. Studies of recovery will start at the end of the diesel oil exposure and will continue until 1986. (See also W88-08482) (Author's abstract) W88-08486

SETTLEMENT, GROWTH AND COMMUNITY STRUCTURE ON GRANITE CHIPS. A COMPARISON BETWEEN FOUR BASINA AT S.E.S. AND A SHELTERED LOCALITY IN THE OSLOFJORD,

Uppsala Ionospheric Observatory (Sweden). O. A. Follum.

O. A. Folium.

IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, December 1984. p 71-80, 6 fig. 1 tab.

Group 5C-Effects Of Pollution

Descriptors: *Water pollution effects, *Oil pollution, "Norway, "Littoral environment, Diatoms, Aquatic environment, Barnacles, Mollusks, Oil, Hydrocarbons, Bacterial, Rocks, Succession, Sea-sonal distribution, Fjords, Norway.

sonal distribution, Fjords, Norway.

The aim of the project was to see how littoral rock communities developed in each of four rocky shore basins, and between one of the control basins and a natural, exposed locality, comparing them with each other and with a natural locality (at Solbergstrand Experimental Station, Norway). The comparison between settlement and availability of organisms in the water can tell something about what kind of communities one can expect, and how effects from oil can be separated from effects of natural events. The first organisms to appear were benthic diatoms. The barnacle, Balanus balanoides, settled down in April, and dominated the primary growth (when not considering the diatoms) from May to September. The barnacles settled and grew as singular individuals in the grazing was greater in the fjord than in any of the basins, because the periwinkles were more abundant. As a preliminary conclusions, the following are proposed: Benthic diatoms were more abundant in basin I because of the oil contamination. This gave less primary growth here than in the other basins, either because a great amount of diatoms prevent other organisms from attaching or because other organisms from attaching or because other organisms do not settle down in heavy oil pollution. Therefore, the diatoms can diatoms prevent other organisms from attaching or because other organisms do not settle down in heavy oil pollution. Therefore, the diatoms can dominate the substrate with little or no competition. The oil could possibly create a bacteria/mucus layer on the substrate on which the diatoms prefer to settle, or which prevents the settling of other organisms. (See also W88-08482) (Lantz-PTT) PTT) W88-08487

POPULATION DYNAMICS OF LITTORINA LITTOREA IN AN OIL CONTAMINATED EN-VIRONMENT AT SOLBERGSTRAND EXPERI-MENTAL STATION.

MENIAL STATION, Oslo Univ. (Norway). K. Moe, and E. Lystad. IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, Decem-ber 1984. p 81-92, 4 fig, 2 tab, 8 ref.

Descriptors: "Water pollution effects, "Oil pollution, "Gastropods, "Benthos, "Solbergstrand, "Norway, Oil, Hydrocarbons, Fjords, Seasonal variation, Population dynamics, Aquatic animals, Animal growth.

The effects of low oil contamination on popula-tions of Littorina littorea (L.) were detected at both individual and population levels. The five populations examined are designed as follows: hol - high oil; LO - low oil; C2 - control 2. C4 - control - high oil; LO - low oil; C2 - control 2, C4 - control 4, CF - control fjord. In July 1982 L. littorea from all basins and fjord (CF) were marked individually and measured for growth every other month unit September 1983. HO values indicate higher growth in all size intervals for the period March to September 1984, than for the same period in 1983. september 1935. Ho Vaules indicate nigner growth in all size intervals for the period March to September 1984, than for the same period in 1983. The very high growth values, especially for individuals in the size interval 15-18 mm, in 1984, draw the picture of the Littorinas in C2. With exception of the individuals in size interval 19-21 mm, the growth values in 1984 are higher than in 1983. As in HO and C2, the growth values of L. littorea in LO, unspecified changes in 1984 compared to 1983. Low growth values for all size intervals characterized the Littorinas in C4. It is only a small, if any, variation between the values in 1984 and 1983. Due to mechanical damage of the CF station in August 1983, there are no growth data obtained after that data in 1983. For this reason, it is hard to compare the 1983 and 1984 periods of growth. Though both data for 1983 and 1984 indicate slow growth for individuals in all size intervals. (See also W88-08482) (Lantz-PTT) W88-08488

POPULATION GENETICS OF LITTORINA LITTOREA AT SOLBERGSTRAND, S. E. Fevolden.

IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, December 1984. p 93-100, 5 tab.

Descriptors: "Water pollution effects, "Oil pollution, "Gastropods, "Population genetics, "Solbergstrand, "Norway, Ecological effects, Mytilus Oil, Hydrocarbons, Biological studies, Genetics, Mussels, Adaptation, Aquatic animals, Animal growth.

An organism, which in addition to Mytilus edulis was found in large numbers in the Solbergstrand basins prior to oil dosing, was Littorina littorea. The presence of low concentration of oil seemed to have much less effect on the L. littorea's ability to survive than it had on M. edulis ability to survive. This fact made it unfeasible to test whethsurvive. This fact made it unleasone to test whether er survival of Littorina was favored by certain genotypes. One year of oil exposure gave evidence for allelic selection in the 6Pgdh-locus for those animals that grew fast under oil stress. Animals animals that grew fast under oil stress. Animals that had been exposed to oil over two years, however, showed no difference in allele frequencies between fast and slow growers. This could indicate a long term adaptation. The slow growing animals will be checked, however, to see if their growth in the initial year of oil exposure were genotypically linked. The larvae's ability to settle has not been proven to be favored by the presence of certain gene alleles. (See also W88-08482) (Lantz-PTT) wes nexten

POPULATION GENETICS OF MYTILUS EDULIS AT SOLBERGSTRAND,

S. E. Pevoluci.

IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, December 1984. p 101-116, 2 fig. 9 tab, 10 ref.

Descriptors: *Water pollution effects, *Oil pollution, *Mytilus, *Solbergstrand, *Norway, *Population genetics, Genetics, Oil, Electrophoresis, Mus-

Genetic differentiation among subpopulations of Mytilus edulis has been widely reported in the literature. This species was therefore chosen as one of two initial species to be studied for potential effects of oil pollution on electrophoretic variants at selected gene loci. The few and minor differences detected between oil-exposed and non oil-exposed samples in this survey do not indicate any strong genetic effect from the low concentrations of oil used. The oil dosing did have a severe effect on the mortality of M. edulis in the basins. For the gene systems that have been studied, adult animals' ability to survive in oil-polluted water could not be determined by genotypic differences. The strongdetermined by genotypic differences. The strong-est evidence for an oil influence was seen among juveniles on the Idh locus. The difference registered between the two years of basin juveniles, do however, indicate that even for this locus, certain other, and unknown, factors must exist for any selection to take place. Also the actual basin effect Mytilus' genetic structure seems to be marginal for the chosen loci. If there is such an effect it could vary from one year to the next and also have a different effect upon different life stages. (See also W88-08482) (Lantz-PTT) W88-08490

SUBLETHAL BIOLOGICAL EFFECTS AND RECOVERY OF MUSSELS (MYTILUS EDULIS) FOLLOWING CHRONIC EXPOSURE TO PETROLEUM HYDROCARBONS: PHYSI-OLOGICAL RESPONSES,

Institute for Marine Environmental Research, Plymouth (England).

Prymouth (England).
J. Widdows, and P. Donkin.
IN: Long Term Effects of Oil on Marine Benthic
Communities in Enclosures. Norwegian Institute
for Water Research Report No. 0-82007, December 1984. p 129-140, 4 fig, 2 tab.

Descriptors: *Water pollution effects, *Lethal limits, *Toxicity, *Mussels, *Oil pollution, Oil, Hydrocarbons, Tissue analysis, Physiological ecology, Mytilus, Biological studies, North Sea, Norway.

Previous laboratory studies have shown that physi-ological and cellular processes of Mytilus edulis are affected by chronic exposure to low and environmentally realistic concentrations of the water accommodated fraction of North Sea crude oil. accommodated fraction of vorth Sed Grude Oil.
The main objectives of this project at the Solbergstrand Experimental Station were: (1) to investigate the sublethal physiological responses of M.
edulis following chronic exposure to two concentrations of petroleum hydrocarbons; and (2) to
study the recovery of M. edulis both in terms of
hydrocarbon contamination of the body tissues and hydrocarbon contamination of the body tissues and the toxic effects of petroleum hydrocarbons. The study found that there was a significant dose-dependent reduction in the feeding rate and scope for growth of M. edulis exposed to the two oil concentrations (30 and 130 micrograms/L). The decline in these physiological responses was inversely related to the concentration of hydrocarbons in the tissues. During a period of 10 days in clean water the physiological responses of M. edulis only partially recovered. After 22 days recovery there was a marked reduction in the tissue hydrocarbon concentration of the high oil group and this was concomitant with a rapid increase in scope for growth. There was evidence of a slight hydrocarbon contamination of the body tissues a and this was concomitant with a rapid increase in scope for growth. There was evidence of a slight overshoot in scope for growth which may give rise to 'catch-up' growth. The rapid decline in tissue hydrocarbon concentration within 22 days was probably the combination of a high depuration rate and a 'dilution effect' due to tissue growth. Recovery of low oil exposed mussels was slower both in terms of tissue depuration and physiological performance. Recovery of both high and low oil groups was complete after about 55 days. (See also W88-0842) (Lantz-PTT) W88-08492

ENERGY BALANCE IN LITTORINA LIT-

Norsk Inst. for Vannforskning, Oslo-T. Bakke.

In State.

IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, December 1984. p 141-152, 5 fig. 3 ref.

Descriptors: *Energy, *Gastropods, *Oil pollution, *Physiological ecology, *Water pollution effects, Ecological effects, Respiration, Ammonia, Season-al variation, Aquatic animals, Animal growth, Benthos, Energy

The energy uptake and loss of four basin popula-tions of Littorina littorea (HO=high oil: LO=low oil; C4=control 4; C2-control 2) and one shore oil; C4=control 4; C2-control 2 and one shore population, was investigated at two month intervals during the dosing period and, after that, until complete recovery. The physiology measurements have shown that during the last 6 months of oil dosage the energy conditions in the two oiled populations were clearly less favorable than in all control populations. Although not tested statistically the HO population showed a gradual decreas: in scope for growth with time, the LO population showed a slight increase. There was also a considerable variation among the control populations with C2 being most similar to the oiled and W (the winkles on the shore outside of the stone pier north of the pump house), being least and W (the winkles on the shore outside of the stone pier north of the pump house), being least similar. Respiration was less affected by oil than feeding, and seemed only to respond to the dosing in June. Ammonia excretion seemed not to be affected by oil with the possible exception of the spring situation when elevated excretion was found in the I/O and Cd completions indicating high spring situation when elevated exerction was found in the HO, 10 and C4 populations, indicating high protein catabolism just at the start of the main feeding season. The last period of measurements was made 14 days after oil dosing had terminated and should therefore cover a possible initial recovery. The measurements showed that HO feeding rates went up significantly from August to Octo-ber, with a corresponding increase in the scope for growth, whereas feeding in the other populations either decreased (C2, W) or stayed the same (LO, C4). Respiration and excretion did not change to any degree that could be linked to oil recovery. (See also W88-08482) (Lantz-PTT) W88-08493

Effects Of Pollution—Group 5C

SUBLETHAL CELLULAR AND MOLECULAR EFFECTS AND SHORT-TERM RECOVERY OF MUSSELS (MYTILUS EDULIS) AND PERIWINKLES (LITTORINA LITTOREA) FOLLOWING CHRONIC EXPOSURE TO PETROLEUM HYDROCARBONS,

LEUM HYDROCARBONS, Institute for Marine Environmental Research, Plymouth (England). M. Moore, D. Livingstone, and D. Lowe. IN: Long Term Effects of Oil on Marine Benthic Communities in Enclosures. Norwegian Institute for Water Research Report No. 0-82007, Decem-ber 1984. p 153-189, 13 tab, 20 ref.

Descriptors: *Water pollution effects, *Oil pollu-tion, *Physiological ecology, *Benthos, *Mussels, *Periwinkles, *Lethal limits, Mytilus, Gastropods, Oil, Hydrocarbons, Toxicity, Cellular physiology,

Previous studies have shown that cellular processes of mussels and periwinkles are affected by chronic exposure to low concentrations of oil-derived hydrocarbons, both in the laboratory and in the field. One recent report showed that comparable cellular and subcellular effects had occurred rable cellular and subcellular effects had occurred in the experimentally exposed mussels and periwinkles at Solbergstrand. This report reflects the continuing investigations and also introduces a new component, namely the investigation of the cytochrome P-450 detoxification/toxification system. The main objectives of this continued investigation were: (1) to investigate the sublethal cellular and The main objectives of this continued investigation were: (1) to investigate the sublethal cellular and molecular responses at two concentrations of hydrocarbons on a seasonal basis; and (2) to study short-term, recovery from and exposure to hydrocarbons in both species. Evidence from this study indicates that mussels and periwinkles continue to show evidence of perturbation of lysosomal function in the digestive cells. NADPH-NTR results are in agreement with the biochemical data for both species. Short-term exposure to hydrocarbons results in rapid (1 day) destabilization of lysosomes. Short-term recovery of lysosomal stability in mussels was fully restored after 53 days in the control system. Mussels do not show any evidence of recovery in the short term. Measurable effects have been demonstrate in both mussels and periwinkles which are consistent with previous data. Details of the response times for recovery and exposure have been elucidated. (See also W88-08494

ORGANIC ENRICHMENT OF SUBTIDAL SEDIMENTS WITH POWDERED ASCHO-PHYLLUM NODOSUM: AN EXPERIMENTAL STUDY IN THE SOFT BOTTOM MESOCOSM AT SOLBERGSTRAND,
For primary bibliographic entry see Field 5B.
W88-08495

DO POLYCYCLIC AROMATIC HYDROCAR-BONS, ACTING AS PHOTOSENSITIZERS, PARTICIPATE IN THE TOXIC EFFECTS OF ACID RAIN, Illinois Univ. at Chicago Circle. Dept. of Chemis-

Kagan, E. D. Kagan, I. A. Kagan, and P. A.

Kagan, D. D. Ragan, R. Kagan. IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p 191-204, 7 fig, 4 tab, 30 ref.

Descriptors: *Phototoxicity, *Toxicity, *Acid rains, *Aromatic compounds, *Hydrocarbons, *Photochemistry, Carcinogens, Population exposure, Sunlight, Chemical properties, Daphnia, Fish populations, Acidity.

The light-dependent toxicity of non-carcinogenic polycyclic aromatic hydrocarbons (PAH) such as naphthalene, fluorene, phenanthrene, chrysene, antracene, 9-methylanthracene, fluoranthene, and pyrene has been examined in Daphnia magna, Artemia salina, immature Aedes aegypti and Aana pipiens, and in fish (Pimephales promelas). Data were obtained in the laboratory, except for the

tadpoles and fish, which were exposed to sunlight. The light-dependent toxicity of the carcinogenic benzo(a)pyrene in mosquito larvae was used for comparison. Although the mechanism of light-dependent toxicity has not been elucidated, the effects are probably too rapid to involve modifications of the genetic material. PAHs are generated in the combustion processes held responsible for acid rain. The results suggest that one must now question whether the death of aquatic organisms in natural environments should be ascribed solely to an increase in acidity. It is possible that some of the ecological damage usually assigned to acid rain might instead be due to photodynamic reactions, particularly in aquatic environments. (See also W88-08526) (Friedmann-PTT) W88-08534

TOXIC SUBSTANCES IN RIVERS AND

STREAMS, Nature Conservancy Council, Peterborough (England). J. M. Hellawell.

Environmental Pollution EPEBD7, Vol. 50, No. 1 and 2, p 61-85, 1988. 6 tab, 106 ref.

Descriptors: *Water pollution effects, *Toxicity, *Pollutants, *Pollutant identification, *Rivers, *Streams, *Poisons, *Heavy metals, *Pesticides, Polychlorinated biphenyls, Field tests, Bioassay.

Many of the toxic substances entering freshwaters Many of the toxic substances entering treshwaters today are those which were present several decades ago, but others have become significant recently. The effects of toxicants in flowing waters are modified by unidirectional transport and dispersion which afford the potential for a degree of self-purification. The chemical quality of the reself-purification. The chemical quality of the re-ceiving water also affects toxicity. Biological fac-tors also contribute to the ultimate effect of pollut-ants. The potential for the accumulation of toxic substances within tissues increases the significance of certain pollutants which may be present in water even though ambient concentrations are very low. The biota of flowing waters may be restored, following catastrophic entry of pollut-ants, by drift from unaffected regions upstream. The range of potential toxic substances is very extensive and includes inorganic poisons, organic poisons, heavy metals, pesticides, and PCBs. Metals, pesticides and PCBs have the greatest for bioaccumulation. Few generalizations can be made regarding the effect of toxic substances on the biota. Each species tends to respond to different regarding the effect of toxic substances on the biota. Each species tends to respond to different toxicants in different ways and even at different stages in its life history. Toxicity tests conducted under controlled laboratory conditions sometimes produce conflicting results; it is not then unexpect-ed that field observations should sometimes vary widely. Determination of toxicity in laboratory tests must be applied with caution to field condi-tions and it is not wise to extrapolate findings to other species and environments. (Author's ab-stract) stract) W88-08562

SILENT EPIDEMIC OF ENVIRONMENTAL METAL POISONING, National Water Research Inst., Burlington (Ontar-

J. O. Nriagu. Environmental Pollution EPEBD7, Vol. 50, No. 1 and 2, p 139-161, 1988. 1 fig, 5 tab, 68 ref.

Descriptors: *Water pollution effects, *Water pol-Descriptors: "water polition effects, "water polition sources, "Population esposure, "Heavy metals, "Public health, "Toxins, Epidemiology, Metal poisoning, Air polltion, Water polltions, Developing countries, Urban areas, Trace metals, Drinking water, Soils, Fish, Tissue

The main objective of this paper is to provoke and stimulate debate on the health effects of long-term, low-level exposure of human populations to toxic metals. Sources of trace metals in the environment, prevalence of subclinical effects of metal poisoning on the general population, and trace metals as confounding factors in other disease are discussed. Over one billion human 'guinea-pigs' are now being exposed to elevated levels of toxic metals

and metalloids in the environment. The number of persons suffering from subclinical metal poisoning is believed to be several million. A large portion of the cases are in developed countries but the urban areas of developing countries have become hotspots of metal pollution, and the populations of such countries are particularly susceptible to environmental toxins. Metal exposure derives from such sources as drinking water, soils and crops, and fish and seafoods. As a global problem, the potential health effects of metallic hazards should be a matter of public health concern, especially if the emissions of toxic metals into the environmental continues at the current rate. (Roseman-PTT) tal continues at the current rate. (Roseman-PTT) W88-08563

REDUCTION IN ORGANIC EFFLUENT STATIC ACUTE TOXICITY TO FATHEAD MINNOWS BY VARIOUS AERATION TECH-

Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Biology. For primary bibliographic entry see Field 5G. W88-08564

EFFECTS OF SODIUM PENTACHLORO-PHENATE ON THE ECOLOGY OF A FRESH-WATER MODEL ECOSYSTEM,

Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Botanik, Lehrgebeit Systematik und Oe-

kophysiologie. D. Feind, F. J. Zieris, and W. Huber. Environmental Pollution EPEBD7, Vol. 50, No. 3, p 211-223, 1988. 10 fig. 28 ref.

Descriptors: "Water pollution effects, "Ecosystems, "Macrophytes, "Aquatic animals, "Phytoplankton, "Sodium pentachlorophenate, Pollution effects, Rotifers, Cyclopids, Model studies, Environmental effects, Aquatic plants, Pollutants, Water pollution, Microcosms.

An outdoor model ecosystem was designed for the ecotoxicological evaluation of xenobiotics. Two years were necessary before the artificial pond reached a steady state. During this time the composition of the community and its functions were investigated. The authors recorded the amount of position of the community and its functions were investigated. The authors recorded the amount of nutrients and the O2-CO2 metabolism in the water, the density and diversity of the phytoplankton, the aquatic macrophytes and the fauna, the microbial activity in the sediment, and the environmental impacts on the ecosystem. A short time before the application of sodium pentachlorophenate (Na-PCP) the ecosystem was divided into three identical subunits. One of these was used as an internal control, the others were contaminated with two different concentrations of Na-PCP (0.1 and 0.3 mg per 1). These concentrations were maintained over a period of eight weeks. Ecological changes in the contaminated compartments were investigated during a period of one year. The results were compared with those of single-species tests. Significant variations were observed only in the unit receiving (3.3 mg Na-PCP) per 1. A short time after starting the experiment, the number of rotifers and cyclopids decreased. Primary producers were not affected. An increase of the chloride levels in the water indicated degradation processes. One year after application of the chemical, the remineralization of nutrients was disturted. This resulted in diminution of the phytoplankton and the aquatic fauna. (Author's abstract)

BIOINDICATION BY MACROPHYTES - CAN MACROPHYTES INDICATE SAPROBITY (BIOINDIKATION DURCH MAKROPHYTEN -INDIZIEREN MAKROPHYTEN SAPROBIE), Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.). For primary bibliographic entry see Field 5A. W88-08591

POPULATION DYNAMICS OF DUCKWEED COVER IN POLDER DITCHES, Leiden Rijksuniversiteit (Netherlands). Centre for Environmental Studies.

Group 5C-Effects Of Pollution

W. T. de Groot, F. M. W. de Jong, and M. M. H.

E. van den Berg. Archiv fuer Hydrobiologie AHYBA4, Vol. 109, No. 4, p 601-618, June 1987. 6 fig. 2 tab, 16 ref.

Descriptors: *Agricultural runoff, *Polder ditches, *Duckweed, *Limnology, *Aquatic plants, *Eutrophication, *Cycling nutrients, Statistical methods, Plants, Ponds, Nonpoint pollution sources, Water pollution sources, Nitrogen, Phosphates, Species composition, Aquatic habitats.

Excessive duckweed growth threatens the species diversity of Dutch polder ditches. The extent duckweed growth may be ascribed to eutrophication (i.e., the agricultural nutrient input on the land parcels adjacent to the ditches) was investigated in parcels adjacent to the ditches) was investigated in a field study. The study shows that clear relations exist between the nitrogen input and the phosphate concentrations on one hand with duckweed growth and duckweed cover at the other. The correlation coefficients of these relations range between r = 0.71 and r = 0.92. (Author's abstract) W38-08598

EFFECTS OF HEAVY METALS ON THE FRESHWATER SNAIL, SEMISULCOSPIRA BENSONI, IN A CLOSED MINING AREA, (IN JAPANESE).

Nagasaki Prefecture Inst. of Health Science and

Envirnomental Science (Japan). S. Ishizaki, and H. Hamada. Japanese Journal of Limnology, Vol. 48, No. 2, p 91-98, April 1987.3 fig, 5 tab, 22 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Snails, *Semisulcospira bensoni, *Bioindicators, Cadmium, Lead, Zinc, Mortality, Pollutant identification, Path of pollutants, Mine drainage.

The effects of closed mine effluent on the freshwater snail, Semisulcospira bensoni, were studied in the Sasu River in the Tsushima Islands. Concentrations of Cd, Pb, and Zn were consistently higher in the soft parts of the snails from the Sasu River than in those from the Se River, which served as a control river in the Tsushima Islands. The same trend was observed for the concentrations in the shells. The snails collected at the lower reaches of trend was observed for the concentrations in the shells. The snails collected at the lower reaches of the Se River were placed in cages at the lower reaches of the Sasu River and of the Se River itself for a month. The mortality of these snails was significantly higher in the Sasu River than in the Se River. In the Sasu River remarkably high concentrations of heavy metals were detected in the attached substance mainly composed of algae. The heavy metals were not detected in the water of the Se River, while a certain amount of heavy metals was found in those of the Sasu River. The Zn was round in trose of the saist River. Inc 2.n concentration was relatively high. These results suggest that S. bensoni is a useful monitoring orga-nism for the assessment of heavy metal pollution, and the snails may be affected by heavy metals through the food (attached algae) as well as by the ambient water. (Vernooy-PTT) W88-08636

BRANCHIAL PATHOGENESIS IN A FRESH-WATER FISH, PUNTIUS CONCHONIUS HAM., CHRONICALLY EXPOSED TO SUBLE-THAL CONCENTRATIONS OF CADMIUM, Kumaun Univ., Naini Tal (India). Dept. of Zoolo-

T. S. Gill, J. C. Pant, and H. Tewari. Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 153-161, April 1988. 4

Descriptors: *Water pollution effects, *Toxicity, *Fish, *Cadmium, *Heavy metals, Metals, Sublethal effects, Gills.

Effects of sublethal concentrations, 630 and 840 Effects of sublethal concentrations, 630 and 840 micrograms/liter (0.05 and 0.066 fractions of the 96-hour LC50) of cadmium chloride on the gills of a freshwater fish, Puntius conchonius, were examined by light microscopy during a 12-week exposure. The secondary gill lamellae showed disrupted epithelium, necrosis, accumulation of cellular debris, capillary congestion, and wilting of the pillar cell system. Hypertrophy and hyperplasia of

chloride cells as well as partial or complete fusion of secondary lamellae also occurred in the Cdexposed fish. Branchial lesions together with coagulation film anoxia are likely to result in serious respiratory distress and related tissue hypoxia. (Au-

BIOMONITORING OF OIL SPILL IN A BOREAL ARCHIPELAGO BY XENOBIOTIC BIOTRANSFORMATION IN PERCH (PERCA

HOTHANSFORMATION IN PERCH (PERCA FLUVIATILIS), Kuopio Univ. (Finland), Dept. of Physiology. P. Lindstrom-Seppa. Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 162-170, April 1988. 6 fig, 2 tab, 28 ref.

Descriptors: *Water pollution effects, *Oil spills, *Fish, *Toxicity, *Monitoring, *Bioindicators, *Biotransformation, Metabolism, Perch, Gulf of Bothnia, Finland, Enzymes, Sublethal effects.

The effect of an accidental oil spill (250 tons) in a boreal archipelago (Gulf of Bothnia, Vaasa, Finland) on xenobiotic metabolism of local perch (Perca fluviatilis) was monitored for 1.5 years. The monooxygenase (benzo(a)pyrene, 7-ethoxycounarin O-deethylase, 7-ethoxyreourin O-deethylase) and conjugation (UDPglucuronosyltransferase, glutathione 5-transferase) activities of perch liver were determined from control areas and those areas where oil had spilled. Only a slight induction in monooxygenase activities was seen in perch areas where oil had spilled. Only a slight induction in monooxygenase activities was seen in perch caught near the oil spill 4 months after the accident. The induction of monooxygenase activities detected with the fuel oil in laboratory experiments was, however, clear. After a single dose, it rose rapidly and quickly disappeared. Conjugation enzyme activities were not affected in the laboratory. It was concluded that the fish were not severely contaminated with polycyclic aromatic hydrocarbons derived from the fuel oil. The oil accident in the Vaasa archipelago was not very severe; the response did not last long. (Cassar-PTT) W88-08672

TOXIC EFFECTS OF THREE MERCURIAL COMPOUNDS ON SURVIVAL, AND HISTOLOGY OF THE KIDNEY OF THE CATFISH CLARIAS BATRACHUS (L.),

CLARIAS BATRACHUS (L.), Varanasi (India). Centre of Advanced Study in Zoology. R. Kirubagaran, and K. P. Joy. Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 171-179, April 1988. 10 fig. 1 tab, 25 ref.

Descriptors: *Water pollution effects, *Fish, *Mercury, *Heavy metals, *Toxicity, Caffsh, Methylmercuric chloride, Emisan 6, Methoxyethyl mercury chloride, Sublethal effects.

In Clarias batrachus, methylmercuric chloride (CH3HgCl) was 1.18 and 10.05 times more toxic than mercuric chloride (HgCl2) and emisan 6 (methoxyethyl mercury chloride), respectively, for 96 hours. A similar trend was observed at 24, 48, and 72 hours. Exposure of the catfish to sublethal concentrations of these mercurials for 14 and 28 days caused progressive changes in the kidney. The diameter of the proximal convoluted tubules was increased, the epithelial cells were hypertrophied, and the lumen was reduced and filled with secretory material and sloughed-off cells. In 14-day emisan 6-treated fish, some glomeruli were also degenerated. Exposure of the catfish to toxicologically safe concentrations of the mercurials for 90 days caused vacuolation, atrophy, and extensive days caused vacuolation, atrophy, and extensive damage of the tubules in HgCl2- and CH3HgCltreated fish, and hypertrophy and vacuolation of epithelial cells of some tubules in the emisan 6treated fish. Regeneration was noticed in the 90-day HgCl2-exposed group. After 180 days of expo-sure, however, histology of the kidney appeared normal in all the groups. (Author's abstract) W88-08673

ACTION OF MALATHION PLUS LINDANE PESTICIDE ON CRUSTACEAN POPULA-TIONS,

Barcelona Univ. (Spain). Dept. de Ecologia. E. Fores, and F. A. Comin. Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 180-185, April 1988. 4

Descriptors: "Water pollution effects, "Insecticides, "Crustaceans, "Zooplankton, "Lindane, "Malathion, Pesticides, Biocides, Cladocerans, Copepods, Aquatic habitats, Habitats, Rotifers, Rice fields, Ebro River, Spain.

The effects of malathion plus lindane biocide on Moina and Acanthocyclops populations were tested under experimental conditions. The LC50 (24-hour) for Moina was 0.00034 ml/liter. Percent-(24-hour) for Moina was 0.0034 ml/liter. Percentages of Acanthocyclops surviving different biocide doses within the range 0.0002-0.0006 ml/liter were not significantly different from each other. The biocide dose used by the farmers in rice fields in the Ebro River Delta (0.00057 ml/liter) against crustaceans is high enough to control cladoderan and copepod populations. A lower dose would also be successful. Recovery of the zooplankton populations in rice fields after biocide use is initially accomplished by Rotifera spp. and then by crustaceans. This takes place mainly through the irrigation channel. (Author's abstract) W88-08674

TOXICITY OF AN ANIONIC DETERGENT, DODECYLBENZENE SODIUM SULFONATE, TO A FRESHWATER FISH, RITA RITA: DETERMINATION OF LC50 VALUES BY DIFFERENT METHODS, Banaras Hindu Univ., Varanasi (India). Dept. of Zeology.

Zoology.

D. Roy.
Ecotoxicology and Environmental Safety
EESADV, Vol. 15, No. 2, p 186-194, April 1988. 2
fig, 5 tab, 6 ref.

Descriptors: *Water pollution effects, *Fish, *Toxicity, *Surfactants, *Detergents, Sodium dodecylbenzene sulfon: te, Bioassay, Assay, Fish behavior.

LC50 values and their 95% confidence limits were LC30 values and their 95% confidence limits were obtained for various intervals of exposure of Rita rita specimens to sodium dodecylbenzene sulfonate using the following methods: graphic method (7.16 mg/liter), logistic method (7.09 mg/liter), Spearman-Karber estimation (6.926279 mg/liter), and trimmed Spearman-Karber method (6.98890 mg/liter). trimmed Spearman-Karber method (6.96890 mg/ liter, 20% trimmed). The rapid graphic method and the probit and logit methods were not found suitable for routine bioassays. The Spearman-Karber method functioned well only with small sample sizes. The trimmed Spearman-Karber esti-mation was reasonably precise and accurate and was deemed the most advantageous for a series of bioassays. Fish in low detergent concentrations (<7 mg/liter) showed little change in behavior. However, at higher concentrations they showed rapid jerky movement, restlessness, muscle spasm, and body torsion. (Cassar-PTT)

IMPACT OF DETERGENTS ON THE PROTEIN HISTOCHEMISTRY OF VARIOUS CELL TYPES OF THE GILL EPITHELIUM OF RITA

Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.

Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 206-211, April 1988. 2 tab, 10 ref.

Descriptors: *Water pollution effects, *Fish, *Toxicity, *Surfactants, *Detergents, Sodium dodecylbenzene sulfonate, Gills, Proteins.

Fish, Rita rita, were exposed to an anionic detergent, sodium dodecylbenzene sulfonate, 6.9 mg/liter of tap water (96-hour LC50 of the detergent). A gradual decrease in the protein constituents of the major cell types, viz, the epithelial cells and the goblet mucous cells in the epithelium lining the gill arch, gill filament, and club cells present only in the gill arch epithelium was observed by using a

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series of histochemical techniques. The results indicate that the detergent action on the gill epithelium is instant and that the detergents may be exerting their effects not only by contact but also may be penetrating through the membrane. (Cassar-PTT) W88-08670

MODULATION OF CARBOHYDRATE ME-TABOLISM IN THE SELECTED TISSUES OF MARINE PRAWN, PENAEUS INDICUS (H. MILNE EDWARDS), UNDER PHOSPHAMI-DON-INDUCED STRESS, Sri Venkateswara Univ., Tirupati (India). Dept. of

Marine Zoology.

M. Srinivasulu Reddy, and K. V. Ramana Rao.

M. Srinivasulu Reddy, and Environmental San April 19. Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 212-220, April 1988. 5 tab. 31 ref.

Descriptors: *Water pollution effects, *Metabolism, *Carbohydrates, *Insecticides, *Phosphamidon, *Shrimp, Pesticides, Sublethal effects, En-

Changes in carbohydrate metabolism were studied in midgut gland, muscle, and gill tissues of marine prawn Penaeus indicus exposed to a sublethal concentration (0.3 ppm) of phosphamidon. A significant decrease in glycogen and pyruvate and an increase in lactate content were observed in all phosphamidon-exposed prawn tissues after 96 hours. An increase in phosphorylase a and aldolase activity levels suggested the increased formation of triose sugars during phosphamidon toxicity. LDH activity was considerably decreased, and an increment in lactate content was observed, indicating reduced mobilization of pyruvate into the citric acid cycle. Glucose-6-phosphate dehydrogenase activity was considerably increased, suggesting the enhanced oxidation of glucose in the hexose monophosphate shunt pathway. Krebs cycle enzymes such as NAD-isocitrate dehydrogenase, succinate dehydrogenase and malate dehydrogenase were decreased, suggesting an impairment in mitochondrial oxidative metabolism due to the acute toxic impact of phosphamidon. Cytochrome-c oxidase and Mg+ + ATPase activity levels were also decreased considerably, suggesting impaired energy synthesis and breakdown during phosphamidon toxicity, as a result of reduced oxidation of glucose acrobically. The increase in acid and alkaline phosphatase activities indicates the enhanced breakdown of phosphamidon-induced stress. These results suggest that phosphamidon has a profound effect on the oxidative metabolism of prawn, which results in the triggering of compensatory metabolic pathways for survivability. (Author's abstract) W88-08677

IMPACT OF ENDOSULFAN (THIODAN) EC 35 ON BEHAVIOR AND DYNAMICS OF OOCYTE DEVELOPMENT IN THE TELEOSTEAN FISH, COLISA (TRICHOGASTER) FASCIATUS Pachhunga Coll., Aizawi (India). Dept. of Zoolo-

A. C. Pandey.

Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 2, p 221-225, April 1988. 3 fig, 2 tab, 15 ref.

Descriptors: *Water pollution effects, *Fish, *Eggs, *Toxicity, *Insecticides, Endosulfan, Pesticides, Fish eggs, Fish reproduction., Sublethal ef-

Histomorphological responses of the ovary of a freshwater percoid fish, Colisa (T.) fasciatus, to treatment with the pesticide, endosulfan or thiodan EC 35, were recorded. Adult sexually mature females used in the study were in the prespawning phase of the ovarian cycle. The 30-day experiment was conducted under natural room temperature and day-night length. Fish were maintained in 1 pmm endosulfan solution, which was changed on ppm endosulfan solution, which was changed on alternate days after feeding with minced goat liver. The following changes were observed in the treat-ed fish: (1) ovarian activity was retarded; (2) the ovarian wall became thicker; (3) the diameter of oogonia and stage I oocytes was not changed but

that of stages II and III oocytes was greatly reduced; (4) the percentage of stage I oogonia and atretic oocytes increased considerably, that of stages II and II oocytes diminished significantly; and (5) yolk in stage III oocytes appeared clumped and damaged. (Cassar-PTT) W88-08678

IN VIVO RECOVERY OF ACETYLCHOLINES-TERASE ACTIVITY FROM PHOSPHAMIDON AND METHYLPARATHION INDUCED INHI-BITION IN THE NERVOUS TISSUE OF PEN-AEID PRAWN (METAPENAEUS MONO-

CEROS), Sri Venkateswara Univ., Tirupati (India). Dept. of

Sri Venkateswara Univ., Tirupati (India). Dept. of Marine Zoology.

M. Srinivasulu Reddy, and K. V. Ramana Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 752-758, May 1988. 2 tab, 16 ref.

Descriptors: *Water pollution effects, *Insecticides, *Shrimp, *Toxicity, *Phosphamidon, *Methyl parathion, Pesticides, Acetylcholinesterase, Sublethal effects, Organophosphorus pesticides, Enzymes

Acetylcholinesterase activity levels were assayed in the nervous tissue of prawn (Metapenaeus monocros) exposed to lethal and sublethal concentrations of two insecticides for up to 48 hours. Exposure to phosphamidon at concentrations of 0.4 and 1.2 ppm reduced acetylcholinesterase activity by 28.03% and 53.61%. respectively. Smaller concentrations of methylparathion were required to produce similar effects; 34.88% reduction of acetylcholinesterase activity at 0.04 ppm and 63.60% at 0.12 ppm. After transfer of the pesticide-exposed prawns to toxicant-free water, acetylcholinesterase activity in nervous tissue showed a progressive recovery-almost normal within 7 days for the sublethal doses. Prawns exposed to lethal concentrations failed to reach control values, indicating damage to nervous tissue and retention of organo-Acetylcholinesterase activity levels were assayed damage to nervous tissue and retention of organo phosphate in tissues. (Cassar-PTT) W88-08685

CADMIUM INDUCED INHIBITION OF THE NA+/K+ ATPASE ACTIVITY IN TISSUES OF CRAB SCYLLA SERRATA (FORSKAL), Ramniranjan Jhunjhunwala Arts and Science Coll., Ghatkopar (India). Dept. of Zoology. D. M. Dhavale, V. B. Masurekar, and B. A.

Giridhar.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 759-763, May 1988. 1 tab, 15 ref.

Descriptors: *Water pollution effects, *Cadmium, *Heavy metals, *Crabs, *Toxicity, Crustaceans, Metals, Enzymes, Sublethal effects.

ATPase activity was measured in gill and hepato-pancreas of Scylla serrata (Forskal) crabs after exposure to 0.3-24.0 mg/liter cadmium chloride for exposure to 0.3-24.0 mg/liter cadmium chloride for 4 to 30 days. In a four-day exposure at 24.0 mg/liter Cd, the % inhibition of ATPase activity was 62.45% in gill tissue and 36.6% in hepatopancreas tissue. Enzyme activity inhibition at lesser Cd concentrations and longer exposure periods ranged from 25.63% to 71.01% in gill tissue and from 13.8% to 62.01% in hepatopancreas tissue. The mechanism of toxicity was attributed to aberrations in osmoregulation. (Cassar-PTT) W88-08686

EFFECTS OF PULSED- AND SPIKED-EXPO-SURE TO METHOXYCHLOR ON EARLY LIFE

SURE TO METHOXYCHLOR ON EARLY LIFE STAGES OF RAINBOW TROUT, Alberta Environmental Centre, Vegreville. T. A. Hemig, E. J. McGuinness, L. M. George, and K. A. Blumhagen.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 764-770, May 1988. 4 tab, 10 ref.

Descriptors: *Water pollution effects, *Fish, *Insecticides, *Methoxychlor, *Trout, *Toxicity, Pesticides, Fish reproduction, Eggs, Fish eggs.

Exposure of eyed-eggs of rainbow trout to pulsed methoxychlor applications at concentrations up to 580 microgram/liter had no detectable impact on egg hatchability, the timing of 50% hatch, the duration of 95% hatch, or on subsequent alevin survival. Likewise, 2-hour pulsed exposure of 3-day-old- alevins to up to 402 microgram/liter of methoxychlor had no effect on alevin survival. In spiked studies, methoxychlor at concentrations of <0.03, 1.0, and 9.2 microgram/liter was applied to rainbow trout eggs at 1.5 days after fertilization and effects studied for 68 days. Spiked exposure up to 9.2 microgram/liter did not significantly change the rate of yolk absorption, yolk-to-tissue conversion efficiency, rate of tissue growth, or maximum tissue weight achieved on yolk alone. Neither development nor composition of trout were affected. No effects were noted on egg hatchability or subsequent alevin survival. However, at the highest concentration tested, premature hatching was noticed. This is a reaction to adverse environmental stress. This was deemed of minimal biological significance because of the absence of subsequent effects on fish size, composition, and developmental stage. (Cassar-PTT) W88-08687 Exposure of eyed-eggs of rainbow trout to pulsed

DIETARY EXPOSURE OF BLUEGILLS (LEPO-MIS MACROCHIRUS) TO (75) SE: UPTAKE AND DISTRIBUTION IN ORGANS AND TIS-

Miami Univ., Oxford, OH. Dept. of Zoology.
R. B. Gillespie, P. C. Baumann, and C. T. Singley.
Bulletin of Environmental Contamination and
Toxicology BECTA6, Vol. 40, No. 5, p 771-778,
May 1988. 1 fig. 2 tab, 18 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Selenium, *Fish, *Bioaccumulation, Accumulation, Bluegills.

sue distribution of Se75 was studied in bluegills Tissue distribution of Sc75 was studied in bluegills fed with mealworms injected with labeled selenomethionine. Uptake of isotope was greatest in liver tissue (range of mean activity, 0.89-1.66 microCl/g protein). Testis tissue accumulated 0.55-0.90 microCl/g protein. Ovary, heart, blood, and skeletal muscle accumulated the least (0.19-0.51 microCl/g protein). Activity in liver and testis over the 12-week exposure period increased, whereas that in skeletal muscle and heart remained nearly constant (Csex.PTT). stant. (Cassar-PTT) W88-08688

TOXICITY OF SELECTED INSECTICIDES (THIODAN, SECURITY, SPARTAN, AND SEVIN) TO MOSQUITOFISH, GAMBUSIA AF-

Southern Univ., Baton Rouge, LA. Dept. of Bio-

Southern Univ., nation Rouge, L.A. Dept. of Biological Sciences.

S. M. Naqvi, and R. Hawkins.
Bulletin of Environmental Contamination and
Toxicology BECTA6, Vol. 40, No. 5, p 779-784,
May 1988. 2 tab, 14 ref. NIH Grant No. 8135.

Descriptors: *Water pollution effects, *Insecticides, *Fish, *Toxicity, Mosquitofish, Endosulfan, Carbaryl, Pyrethrins, Malathion, Pesticides,

LC50 values for several insecticides on a nontarget species, mosquitofish, were as follows: Thiodan (endosulfan, 50% wettable powder), 1.3 microgram/liter; Spartan (synthetic pyrethroid, 47% active ingredient), 12.0 microgram/liter; Security, 65.1 m analation formulation), 0.2 mg/liter, and Sevin (5% carbaryl), 204.0 mg/liter. The LC5 values for the above materials were Thiodan, 0.48 microgram/liter; Security, 4.10 microgram/liter, Spartan, 0.07 mg/liter, and Sevin, 103.00 mg/liter. The LC99 values were 5.1 microgram/liter, 53.1 microgram/liter, 1.14 mg.liter, and .356 mg/liter, respectively. It is suggested that Sevin may be one of the safest insecticides that could be used near natural waters containing mosquitofish population. natural waters containing mosquitofish population. (Cassar-PTT) W88-08689

DAILY STUDY OF THE DIATOM SPRING BLOOM AT ROSCOFF (FRANCE) IN 1985: I.

Group 5C-Effects Of Pollution

THE SPRING BLOOM WITHIN THE ANNUAL

Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).

For primary bibliographic entry see Field 21. W89-08725

EFFECTS OF MICRO-SCALE IN SITU ENVI-RONMENTAL GRADIENTS CONCERNING WATER QUALITIES ON THE STRUCTURE OF PHYTOPLANKTON IN A COASTAL EM-BAYMENT.

Hiroshima Univ. (Japan). Inst. of Environmental Chemistry

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 4, p 447-458, October 1987. 4 fig, 4

Descriptors: "Water pollution effects, "Eutrophication, "Environmental gradient, "Phytoplankton, "Coastal waters, "Bays, Aquatic habitat, Species diversity, Physical properties, Chemical properties, Salinity, Water temperature, Nutrients, Hiroshima Bay, Japan Bay, Japan.

An attempt was made to clarify the effects of micro-scale in situ environmental gradients concerning water qualities on the structure of the phytoplankton community in Hiroshima Bay, Japan. These water qualities interact in such a way that they should be considered simultaneously with habitat, particularly in a semi-enclosed coastal embayment which is heavily exposed to various pollution stresses. The differentiation in the phytoplankton community structure over an environmentally heterogeneous area, much of which is related to fluctuations in the physical and chemical environmentally fluctuations in the physical and chemical environ-ments, was well documented for micro-scale in situ environmental gradients using the diversity index. The effects of salinity, water temperature, and nutrients are not always equal in magnitude on the structure of the phytoplankton community because the degree of locally dominant in situ environmental gradients is variable over both time and space. However, the physical factors, such as salinity and water temperature, appeared to play a more impor-tant role in determining the structure of the phyto-plankton community in a semi-enclosed coastal embayment. (Author's abstract) W88-08729

ACCUMULATION OF PERIPHYTON BIO-MASS ON ARTIFICIAL SUBSTRATES DE-PLOYED NEAR A SEWAGE SLUDGE OUT-FALL IN SOUTH AUSTRALIA,

South Australia Engineering and Water Supply Dept., Salisbury. State Water Labs. V. P. Neverauskas

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 5, p 509-517, November 1987. 3 fig. 3 tab. 19 ref.

Descriptors: *Water pollution effects, *Epiphytes, *Substrates. *Sludge disposal, *Outfall, Becarriptors: "water pointion effects, "Epiphytes, Biomass, "Substrates, "Sludge disposal, "Outfall, "Outfall sewers, Digested Sludge, Sludge, "Ecological effects, Environmental effects, Gulf St. Vincent, Australia, Bays, Sea grasses.

Digested studge from the Port Adelaide Sewage Treatment Works has been discharged in Gulf St. Vincent, a marine embayment in South Australia, since 1978. The outfall was sited in seagrass mead-ows and four years after it began operating the dominant seagrass species were lost from an area of 365 ha. Discernible effects extended over 1900 or 305 na. Discernible effects extended over 1900 ha and the seagrass beds in partially affected areas were characterized by unusually heavy growth of epiphytes. Artificial substrates were used to assess the accumulation of 'epiphyte' (periphyton) biomass in areas affected by sludge and at a control site. The greatest accumulation was recorded in the area most affected by sludge, i.e., the area from which all seagrass has been lost. It is suggested that excessive accumulation of epiphytes, resulting from the addition of sludge to the water column, may have contributed to the decline of the original seagrass beds. (Author's abstract)

NUTRIENT LIMITATION OF PHYTOPLANK-TON BIOMASS IN A BRACKISH WATER BAY HIGHLY INFLUENCED BY RIVER DIS-

Lund Univ. (Sweden). Dept. of Marine Ecology.

E Graneli. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 25, No. 5, p 555-565, November 1987. 7 fig, 36

Descriptors: "Water pollution effects, "Nutrients, "Limiting nutrients, "Phytoplankton, "Biomass, "Nitrogen, 'Brackish water, "Bays, Estuaries, Agricultural watersheds, Stream discharge, Experimental data, Phosphorus, Silica, Trace elements, Chelating agents, Kattegat, Sweden.

Thirty laboratory nutrient enrichment experiments with the indigenous phytoplankton community from the brackish (mean salimity 16 parts per thousand) Labolm Bay, south-east Kattegat, Sweden were performed during the period August 1981 to August 1983. The results show that nitrogen is the laboratory of the state of the saliminary autrient for potential phytoplankton August 1983. The results show that nitrogen is the most limiting nutrient for potential phytoplankton biomass formation, despite a high input of inorganic nitrogen to the bay from rivers draining heavily-fertilized agricultural areas. Phosphorus, silica, trace-metal, or chelator (EDTA) additions to Laholm Bay phytoplankton had no significant effect on biomass yield. Only close to the river outlets could phosphorus limitation occasionally be found. (Shidler-PTT) WRS-R673.

ASPECTS OF SESARMA CATENATA (GRAPSIDAE, CRUSTACEA) BURROWS AND ITS IMPLICATIONS IN THE EVENT OF AN OIL

Port Elizabeth Univ. (South Africa). Dept. of Zo-

ology.
D. E. Malan, T. Erasmus, and D. Baird.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 26, No. 1, p 95-104, January 1988. 1 fig. 3 tab,

Descriptors: *Water pollution effects, *Oil pollution, *Oil spills, *Ecological effects, *Crustaceans, *Crabs, Animal behavior, Animal physiology, Mud, Tides.

The shape and dimensions of Sesarma catenata crab burrows were determined by means of polyester resin casts. Relationships between burrow entrance size and volume as well as burrow entrance trance size and volume as well as burrow entrance size and size of the occupant crab were established. The 'average' crab burrow penetrated into the mud by a distance of 11.34 cm from the surface at an angle of 55.5 degrees resulting in a depth of 8.94 with a volume of 15.68 ml. The drainage rates of artificial crab burrows were determined and it was established that, depending on distance from the salting cliff, these burrows were between 48.5% and 22.9% full of water at the end of the tidal cycle. The natural crab burrows contained between 0% and 5% water at this stage. The crab burrows penetrated an average of 14.9% of the distance between the surface and the sea water level. In the event of an oil spill the crabs will come into direct contact with the oil when the water drains from the burrows during the ebbing water drains from the burrows during the ebbing tide or when they climb out of the burrow under conditions of increasing hypoxia. This carapace contamination by oil will result in adverse effects on the physiology and behavior of these crabs. (Author's abstract)

W88-08742

EXPANDING ROLE OF NATURAL RE-SOURCE DAMAGE CLAIMS UNDER SUPER-FUND.

ry bibliographic entry see Field 6E.

EFFECTS OF FOREST FLOOR LEACHATE ON SULFATE RETENTION IN A SPODOSOL

Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard.
For primary bibliographic entry see Field 5B.
W88-08757

SULFATE MOBILITY IN AN ACID DANISH FOREST SOIL, Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology. For primary bibliographic entry see Field 5B.

FIELD STUDIES ON ZOOPLANKTON-CYAN-OBACTERIA INTERACTIONS,

New Hampshire Univ., Durham. Dept. of Zoolo-

gy. For primary bibliographic entry see Field 2H.

EFFECTS OF METALS ON FISH BEHAVIOR:

Iowa State Univ., Ames. Dept. of Animal Ecolo-G. J. Atchison, M. G. Henry, and M. B.

Sandheinrich.

Environmental Biology of Fishes EBFID3, Vol. 18, No. 1, p 11-25, January 1987. 3 tab, 105 ref.

Descriptors: "Toxicity, "Heavy metals, "Fish behavior, "Fish, "Predation, "Water pollution effects, "Literature review, "Path of pollutants, "Bioassay, "Population, Locomotion, Ventilation, Cough rate, Feeding, Behavioral toxicity, Predator avoidance, Lethal limit. Descriptors: *Toxicity, *Heavy metals, *Fish be-

Behavioral toxicity tests, if properly designed, can be used in conjunction with standard acute letha-lity tests, chronic full or partial life cycle tests, and early life stage toxicity tests to add ecological realism to toxicant assessments and the regulations made as an outgrowth of these assessments. Changes in certain fish behaviors, especially cough Changes in certain fish behaviors, especially cough rate and avoidance reactions, are very sensitive indicators of sublethal exposure to metals. Other test involving predator avoidance, feeding behavior, learning, social interactions, and a variety of locomotor behaviors show promise but have been insufficiently studied to judge their sensitivity or utility. No behavioral tests have been standardized and few have been verified in the field. We discuss the behavioral tests that have been used with metals examine their sensitivity compared with the benavioral tests that nave been used with metals, examine their sensitivity compared with standard laboratory toxicity tests, and assess the potential ecological significance of the behavioral changes observed. (Author's abstract) W88-08783

EFFECT OF LOW PH AND ALUMINUM ON THE OLFACTORY ORGAN OF RAINBOW THE OLFACTORY ORGAN TROUT, SALMO GAIRDNERI,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst. D. A. Klaprat, S. B. Brown, and T. J. Hara. Environmental Biology of Fishes EBFID3, Vol. 22, No. 1, p 69-77, May 1988. 3 fig. 46 ref.

Descriptors: *Water pollution effects, *Pollutant identification, *Hydrogen ion concentration, *Aluminum, *Olfaction, *Physiological ecology, *Trout, *Sulfuric acid, 'Acid rain, 'Acidic water, Metals, Scanning electron microscopy.

The effects of acid (H2SO4) and aluminum (AlKSO4) in acidified water on rainbow trout, Salmo gairdneri, olfactory organs were examined Samo garroner, onactory organs were examined using scanning electron microscopy and electrophysiology. Exposure to pH 4.7 resulted in an increase in the number of mucus droplets over parts of the olfactory epithelium, primarily along the ridges of the secondary folds. The addition of aluminum (5.0, 9.5, 20.0 micromole/) at pH 4.7. aluminum (5.0, 9.3, 20.0 micromole/l) at pH 4.7 resulted in loss of receptor cell cilia, irregularly shaped olfactory knobs, clumped microvilli and swellings on microridge cells. Electrical responses recorded from the olfactory nerve in response to the amino acid L-serine were similar to controls in fish exposed to acidified water. When fish were exposed to acidified water and aluminum, the response was depressed. These morphological and sponse was depressed. These morphological and electrophysiological changes could be used to indi-cate metal-induced stress in fish from natural eco-systems. (Author's abstract) W88-08785

Effects Of Pollution-Group 5C

PATTERNS OF DARK 14CO2 INCORPORA-TION BY NATURAL MARINE PHYTOPLANK-TON COMMUNITIES, Democritos Nuclear Research Center, Athens

For primary bibliographic entry see Field 2L. W88-08790

MICROBIAL ECOLOGY OF A SHALLOW UN-CONFINED GROUND WATER AQUIFER POL-LUTED BY MUNICIPAL LANDFILL LEACH-ATE Oklahoma Univ., Norman. Dept. of Botany and

Oktainia Chir, Norman: Dept. of Botally and Microbiology.

R. E. Beeman, and J. M. Suflita.
Microbial Ecology MCBEBU, Vol. 14, No. 1, p 39-54, 1987. 3 fig. 3 tab, 36 ref. EPA Assistance Agreement. CR-812808 and CR-811146.

Descriptors: *Groundwater, *Aquifers, *Ground-water pollution, *Landfills, *Water pollution ef-fects, *Unconfined aquifers, *Water pollution, *Municipal wastes, *Methane, *Microbiological studies, *Oklahoma, *Leachates, Microscopic anal-ysis, Landfill leachate, Microbial ecology.

The microflora of a shallow anoxic aquifer underlying a municipal landfill in Oklahoma was characterized by direct light microscopy, most probable number of determinations of sulfate reducers and methanogens, and measurements of methanogeness in aquifer samples containing either endogenous or exogenous electron donors and various sulfate or exogenous electron donors and various suitate concentrations. Acridine orange direct counts of bacteria did not vary significantly with time or between 2 major sampling areas (1.70 + or - 0.16 times 10 to the 7th power to 11.2 + or - 2.1 times 10 to the 7th power cells/gdw). One site (B) was high in organic matter and low in sulfate, and with the content of the night in organic matter and low in suitate, and methanogens generally outnumbered sulfate-reducers at most times of the year, whereas the opposite was true for another site (A). Greater than 75% of the theoretical amount of methane was detected within 7 weeks in both site A and B aquifer slurries amended with noncompetitive electron donors like methanol and trimethylamine. However, only site B slurries efficiently converted competitive donors like acetate, H2, and formate to the expected amount of methane. A mapping of sulfate and methane levels indicated that site A is relatively localized. These results suggest that the predomi-nant flow of carbon and energy through methanogenesis at aquifer B whereas suffate reduction pre-dominated at site A. However, both methanogens and sulfate reducers could be isolated from either site. (Author's abstract) W88-08792

COMMUNITY STRUCTURE OF SESSILE HE-TEROTROPHIC BACTERIA STRESSED BY ACID MINE DRAINAGE, Virginia Univ., Charlottesville. Dept. of Environ-

winging Only, Charlottesvine, Dept. of Environ-mental Sciences, A. L. Mills, and L. M. Mallory, Microbial Ecology MCBEBU, Vol. 14, No. 3, p 219-232, 1987. 2 fig, 6 tab, 29 ref. NSF Grant DEB-82-06827

Descriptors: *Bacteria, *Acidic water, *Mine drainage, *Acid mine drainage, *Water pollution effects, *Microbiological studies, Hydrogen ion concentration, Path of pollutants, Comparison

Microbial communities that developed on glass slides suspended in acid-polluted (pH=2.9) and nonpolluted (pH=6.5) but otherwise similar waters showed evidence of stress when suspended at the opposite station. Glucose incorporation was inhibited in both translocated communities, but the inhibition was not as severe and recovery of activiinhibition was not as severe and recovery of activi-ty was faster for the acid-developed community as compared with the circumneutral community. The communities contained a substantially different set of members with little overlap. The range of pH values at which the members of the acid-developed community could function suggested that the members of that community were generalists, as opposed to narrowly constrained members of the community from the circumneutral station. Based on the proportion of test characters that received

positive responses, the organisms from the acidic site were more general in their abilities (47.6% positive) as compared with the neutral counterparts (18.7% positive). The results support the concept that communities developed in extreme environments tend to be generalists, whereas those from mesic environments, due to the higher levels of competition present, tend to be specialists. Furthermore, the study of microbial communities in dynamic systems such as streams and reservoir inflows is facilitated by the use of solid surfaces which allow an assemblage of nontransient microbes to develop. (Author's abstract) W88-08797

COMPARISON OF THE IN SITU SURVIVAL AND ACTIVITY OF KLEBSIELLA PNEUMON-IAE AND ESCHERICHIA COLI IN TROPICAL MARINE ENVIRONMENTS,

Puerto Rico Univ., Rio Piedras. Dept. of Biology. A. J. Lopez-Torres, L. Prieto, and T. C. Hazen. Microbial Ecology MCBEBU, Vol. 15, No. 1, p 41-57, 1988. 10 fig. 1 tab, 36 ref. NIH Public Health Service Grants and RR-2657 and Universi-ty of Puerto Rico Sea Grant R/LR-08-87-THAI.

Descriptors: *Water pollution effects, *Marine en-Descriptors: "water pollution enecus, "Marine environment, "Tropical regions, "Microbiological studies, "Mangrove swamps, "Path of pollutants, "Escherichia coli, "Klebsiella, Wastewater, Effluents, Organic loading, In situ tests, Comparison

A near-shore coastal mangrove island receiving untreated sewage and a coastal cove receiving rum distillery effluent in Puerto Rico were examined for their ability to support survival and activity of Klebsiells pneumoniae and Escherichia coli. Pure cultures of both bacteria were monitored for 96 hours in situ at both locations using membrane diffusion chambers. K. pneumoniae survived at all sites as measured by AODC and Coulter Counter direct counts. However, at the mangrove island less than 20% of the K. pneumoniae population was active (AODC) after the first 3 hours and less than 10% of this population was respring. In conwas active (AODC) after the first 3 hours and less than 10% of this population was respring. In contrast, the coastal area which was receiving run distillery effluent was able to maintain 40% of the K. pneumoniae population in an active state with 90% respiring. The E> coli population declined by two orders of magnitude at the mangrove island, but remained unchanged at the rum distillery outfall. The E. coli population had a higher proportion of active cells and respiring cells than K. pneumoniae at all sites. At the rum distillery site, the E. coli population was remarkable in that site, the E. coli population was remarkable in that 95% remained active and 95% were respiring. This study suggests that, when sufficient organic loading exists, E. coli, a 'nonsurvivor', can overcome the bactericidal effects of tropical marine waters. K. pneumoniae, a 'survivor', could survive under A. pneumonae, a survivor, count survive under all conditions but could not maintain the activity or respiration that the E. coli population could, even when high organic loads were present. Mor-phological changes related to nutrient stress in the tropical marine environment were apparent in E. coli, but not in K, pneumoniae. Based on physiological activity, E. coli is just as much a 'survivor' as K. pneumoniae in tropical marine waters. (Auas K. pneumoni thor's abstract) W88-08801

ECOLOGY OF VIBRIO CHOLERAE IN THE FRESHWATER ENVIRONS OF CALCUTTA, INDIA,

National Inst. of Cholera and Enteric Diseases, Calcutta (India) For primary bibliographic entry see Field 5B.

W88-08805

CHANGES IN NITROGEN, PHOSPHORUS AND PHYTOPLANKTON COMPOSITION DURING THE PAST DECADE IN THE BAY OF ARATU SALVADOR (BAHIA) BRAZIL,

Dow Chemical U.S.A., Midland, MI. Ma and Environmental Toxicology. For primary bibliographic entry see Field 5B. W88-08808 FRESHWATER PLANKTON COMMUNITY SUCCESSION DURING EXPERIMENTAL ACIDIFICATION,

Kent State Univ., OH. Dept. of Biological Sci-

K. E. Havens, and J. DeCosta.

Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 1, p 37-65, November 1987. 8 fig. 10 tab, 28 ref. NSF Dissertation Improvement Grant DEB-8211706.

Descriptors: *Plankton, *Acidification, *Water pollution effects, *Lakes, *Acid rain, West Virginia, Hydrogen ion concentration, Zooplankton, B. mass, Algae, Diatoms, Chlorophyll a, Acid water,

Lakewater inside 2 cu m bags, suspended in Lake O'Woods, West Virginia, was acidified from pH 7.2 to pH 6.5 or 4.5 via incremental H2SO4 additions which reduced the pH by 0.5 units per week to the desired levels. Two bags were untreated controls. Algal and zooplankton species richness declined with increasing acidity. While diatoms and unicellular greens were the dominant control algae, the filamentous green, Mougoetia viridis and the dinoflagellate Peridinium inconspicuum became dominant in all acidified bags. Total algal biomass, measured as chlorophyll a, increased significant of the control of t biomass, measured as chlorophyll a, increased sig-nificantly with acidification, especially at pH 4.5. Total zooplankton abundance increased with acidi-Total zoopankion abundance increased with actual refication to pH 6, where edible algal biomass was high, and decreased in pH 5 and 4.5 bags, where M. virdis and P. inconspicuum accounted for 99% of the total biomass. Copepod abundance declined when pH dropped below 5.5, and at pH 4.5, two small cladocerans, Bosmina longirostris and Chystal Chyman and the companion of the compa dorus sphaericus, became the dominant crusta-ceans. Only one rotifer, Lecane luna, persisted at pH 4.5. Overall, the plankton community in the pH 4.5 bags closely resembled that in nearby acid lakes. (Author's abstract)

EFFECTS OF IMPOUNDMENTS AND WATER POLLUTION ON INVERTEBRATE COMMU-NITIES IN RIVERS AND PLAINS OF THE HARZ MOUNTAINS (WIRKUNG VON TAL-SPERREN UND GEWASSERBELASTUNG AUF INVERTEBRATENGESELLSCHAFTEN IN FLIEBGEWASSERN UND AUEN HARZES),

Technische Univ. Braunschweig (Germany, F.R.). Zoologisches Inst.

G. Rehfeldt.

Archiv fuer Hydrobiologie AHYBA4, Vol. 111, No. 2, p 255-281, December 1987. 6 fig, 6 tab, 100

Descriptors: *Water pollution effects, *Dams, *Aquatic insects, *Germany, *Reservoirs, *Inver-tebrates, *Rivers, Floods, Mountains, River plains, Fauna, Dragonflies, Heavy metals, Acid waters, Gravel, Tributaries, Harz Mountains.

Dams are restricting the discharge of the rivers Innerste and Oker at the Northern Harz mountains (FR Germany). Effects of the dams can be shown (FR Germany). Effects of the dams can be shown as a decrease of temperature and oxygen content. At the slope of the mountains the pollution of both rivers, particularly with heavy metals, is moderate to heavy. In winter, the frequency of Plecoptera increases below the dams as does the frequency of Trichoptera and Diptera at the slope of the mountains. During summer, there are high frequencies of Ephemeroptera in the upper reaches of the Innerste in contrast to the acid sections of the Oker. The effects of the impoundment at the Innerste seem to be greater than at the Oker. Twenty species of dragonflies were found at old tributaries and 23 species at gravel pits from 1980 to 1982/83. Heavy floods in 1981 caused greater differences in the communities at the old tributaries that at the old tributaries than at the non-inundated gravel pits. (Miller-PTT) pits. (Miller-PTT) W88-08820

LIMNOLOGICAL INVESTIGATION OF BIO-GENIC SILICA SEDIMENTATION AND

Group 5C-Effects Of Pollution

SILICA BIOGEOCHEMISTRY IN LAKE ST. MORITZ AND LAKE ZURICH, Michigan Univ., Ann Arbor. Great Lakes Re-

Michigan Univ., Ann Arour. Oreat Lakes Research Div.
C. L. Schelske, H. Zullig, and M. Boucherle.
Schweizerische Zeitschrift fuer Hydrologie
SZHYA6, Vol. 49, No. 1, p 42-50, 1987. 2 fig, 1

Descriptors: *Limnology, *Sedimentation, *Lake sediments, *Silica, *Phosphorus, *Diatoms, *Water pollution effects, Geochemistry, Wastewater dis-posal, Domestic wastes, Lake Zurich, Lake St.

Biogenic silica concentrations were determined from core samples of laminated sediments collected from Lake Zurich and Lake St. Moritz and used to calculate rates of biogenic silica sedimentation. In Lake Zurich, biogenic silica sedimentation. In Lake Zurich, biogenic silica sedimentation in 1894 to nearly 900 g SiO2/sq m/yr in 1896; in Lake St. Moritz, biogenic silica sedimentation increased about 6-fold during the 1936s. Both periods of increased biogenic silica flux followed increased loadings of domestic sewage to lakes. In Lake Zurich, the period of increased flux only lasted for a few years; in Lake St. Moritz, high fluxes were maintained to the top of the core. In Lake Zurich, increased production and sedimentation of diatoms could be maintained only until the silica reservoir in the water mass was depleted; in Lake St. Moritz (0.10 year residence time and a mean depth of 25 m), diatom production depleted; in Lake St. Moritz (0.10 year residence time and a mean depth of 25 m), diatom production and sedimentation was maintained at a high level by rapid replenishment of silica from tributary inputs. Although historical patterns of biogenic silica sedimentation differed for the two lakes, it is hypothesized that increased biogenic silica deposi-tion in both lakes occurred because diatom produc-tion was stimulated by phosphorus enrichment of the water mass and that silica biogeochemistry of both lakes was affected as a result. (Author's ab-stract)

(LA MORTE DU SAGET, UN ANCIEN MEANDRE DU RHONE: BILAN HYDROLOGI-QUE ET BIOGEOCHIMIQUE),

Lyon-I Univ., Villeurbanne (France). Lab. d'Ecologie des Eaux Douces. For primary bibliographic entry see Field 2H. W88-08827

GRAZING BY A COLORLESS FLAGELLATE ON A GREEN ALGAL BLOOM,

Moi Univ., Eldoret (Kenya).
For primary bibliographic entry see Field 2H.
W88-08830

WHITEFISH AS INDICATORS OF CULTURAL

EUTROPHICATION, Staatliches Inst. fuer Seenforschung und Fischer-eiwesen, Langenargen (Germany, F.R.). J. Hartmann.

Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 3, p 343-352, 1987. 3 fig, 6

Descriptors: *Lake Constance, *Fish, *Whitefish, *Trophic levels, *Eutrophication, Eutrophic lakes, Succession, Fishing.

The history of whitefish (Coregonus lavaretus) of Lake Constance during 1893-1983 was re-interpreted. From a comparison of time series, it is concluded that contrary to the former view, major changes in the biology of whitefish in Lake Constance are due to factors other than eutrophication. Yield reduction in the 1960's was caused by a combination of the effect of growth over-fishing and poor year-class success. During the following period which had a high level of eutrophication and an intermediate fishing intensity, whitefish growth remained rapid. Whitefish appear to be a poor indicator of changes in the trophic state of a lake. (Author's abstract) thor's abstract) W88-08832

EFFECT OF INTENSIVE FERTILIZATION OF A BANKSIDE MEADOW ON THE ACTIVITY

OF PLANKTON BACTERIA IN THE RIVER NIDA (SOUTHERN POLAND), Polish Academy of Sciences, Krakow. Zaklad Bio-

logii Wod.

logii wod. A. Starzecka, and G. Mazurkiewicz. Acta Hydrobiologica AHBPAX, Vol. 29, No. 1, p 3-13, 1987. 3 fig, 3 tab, 23 ref.

Descriptors: *Ammonium nitrate, *Biomass, *Bacteria, *Stream biota, *Plankton, *Agricultural runoff, *Nutrients, *Fertilizers, *Biodegradation, *Limnology, *Water pollution effects, Bioaccumulation, Surface runoff, Energy, Rivers, River Nida.

The activity of mixed communities of aquatic bacteria was investigated and the process of bacterial bioaccumulation and destruction was quantitative-ly determined in the water of the River Nida, in a ty determined in the water of the River Nida, in a sector affected by surface run-off from a bankside meadow intensively fertilized in the form of am-monium nitrate. The successive doses of fertilizer did not cause significant changes in the bacterial biomass. The average amount of energy used by bacteria for bioaccumulation and biodegradation was similar at all stations while the direction of the energy flow varied. (Author's abstract) W88-08835

PLANKTON STRUCTURE AND DYNAMICS, PHOSPHORUS AND NITROGEN REGENERA-TION OF ZOOPLANKTON IN LAKE GLEBO-KIE POLLUTED BY AQUACULTURE,

logii. T. Weglenska, L. Bownik-Dylinska, J. Ejsmont-Karabin, and I. Spodniewska. Ekologia Polska ELPLBS, Vol. 35, No. 1, p 173-208, 1987. 13 fig, 6 tab, 59 ref.

Descriptors: "Aquaculture, "Phytoplankton, "Zoo-plankton, "Plankton, "Species composition, "Popu-lation dynamics, "Phosphorus, "Nitrogen, "Cy-cling nutrients, "Trophic level, "Limnology, "Eu-trophication, "Water pollution effects, Aquatic habitats, Lake Glebokie, Biomass, Culturing tech-

Changes in density and dominance structure of phyto- and zooplankton (higher percentage of blue-green algae and Euglenophyta and decrease blue-green algae and Euglenophyta and decrease of nanoplankton, higher percentage of small detritus-bacteriophagous species of ciliates, rotifers and crustaceans), and trophic structure of zooplankton (greater species differentiation and ratio of biomass of predatory forms to that of non-predatory ones, and of ratio of Cyclopoda biomass to that of Calanoida) prove the accelerated eutrophication and degradation of Lake Glebokie - an object of intensive trout cage culture. (Author's abstract) W88-08841

PHOSPHATE EXCHANGE BETWEEN SEDI-MENTS AND THE NEAR-BOTTOM WATER IN RELATIONSHIP TO OXYGEN CONDITIONS LAKE USED FOR INTENSIVE TROUT

CAGE CULTURE, Polish Academy of Sciences, Lomianki. Inst. Ekologii.

R. J. Wisniewski, and M. Planter. Ekologia Polska ELPLBS, Vol. 35, No. 1, p 219-236, 1987. 5 fig, 3 tab, 29 ref.

Descriptors: *Aquaculture, *Phosphates, *Sedi-ment-water interfaces, *Eutrophication, *Limnology, "Cycling nutrients, "Water pollution effects,
"Lake sediments, "Dissolved oxygen, Seasonal
variation, Culturing techniques, Pollution load,
Water chemistry, Lakes, Lake Glebokie, Sedi-

In a cage-culture basin summer and winter oxygen In a cage-culture basin summer and winter oxygen deficits were more serious and comprised a larger part of the hypolimnion than in basin far from the culture. In winter and in summer the bottom sediments released net phosphates into the water (3.4 to 5.6 and 5.2 to 16.6 mg P/sq m/day, respectively), in spring and in autumn they took them up from the water (0.2 and 0.1 to 4.5 mg P/sq m/day). Phosphate release rate varied more widely between consecutive study years than between the two lake basins. Because of oxygen condition dif-

ferences, the annual phosphate load per lake unit surface area was 10 - 50% higher in the culture basin than in the distant basin. (See also W88-08841) (Author's abstract)

ECOLOGY OF A FREE-FLOWING RIVER IN THE SOUTH OF THE ALPS- THE BUECH (FRANCE): I. LONGITUDINAL EVOLUTION OF PHYSICAL AND CHEMICAL DESCRIPTORS (ECOLOGIE D'UNE RIVIERE NON AMENAGEE DES ALPS DUE SUD- LE BUECH: (FRANCE) I. EVOLUTION LONGITUDINALE DES DESCRIPTEURS PHYSIQUES ET CHIMIQUES) ET CHIMIQUES), Aix-Marseille-1 Univ. (France). Lab. d'Hydrobio-

F. Vespini, P. Legier, and A. Champeau.
Annales de Limnolgie ANLIB3, Vol. 23, No. 2, p
151-164, 1987. 9 fig, 2 tab, 11 ref.

Descriptors: "Hydrochemistry, "Limnology, "Water chemistry, "Water pollution effects, "Stream biota, "Ecology, "Physical properties, "Mineralization, "Wastewater disposal, "Eutrophication, Buech River, Trophic level, Rivers,

The hydrochemical composition of the Buech River is studied through a multivariate data analy-sis of longitudinal evolution of thirteen descriptors of the water environment. Thirty-one sampling points on the river's course and its tributaries were points on the river's course and its tributance.

chosen. Upstream to downstream, there is a progressive increase in the water's degree of mineralization. This chemical continum is disturbed by domestic waste water dumping. The analysis distinguishes natural eutrophication from man-made eutrophication. (Author's abstract)

MEDIATED SETTLEMENT OF ENVIRON-MENTAL DISPUTES: GRASSY NARROWS AND WHITE DOG REVISITED,

Windsor Univ. (Ontario). Faculty of Law. For primary bibliographic entry see Field 6E. W88-08854

EFFECTS OF RECENT ACIDIFICATION ON CLADOCERA IN SMALL CLEAR-WATER LAKES STUDIED BY MEANS OF SEDIMEN-

Joensuu Univ. (Finland). Karelian Inst. P. Uimonen-Simola, and K. Tolonen. Hydrobiologia HYDRB8, Vol. 145, p 343-351, February 1987. 6 fig, 1 tab, 17 ref.

Descriptors: *Acid rain, *Water fleas, *Acid rain effects, *Lakes, *Diatoms, *Sediments, *Water pollution effects, *Acidification, *Population dynamics, *Species composition, Biomass, Taxono-

Cladoceran populations, as revealed by sedimentary remains, studied in six lakes which by diatom evidence have become strongly acidified during the past 30 years. The accumulation rates of cladoceran remains and in two of the most strongly acidified lakes both relative and absolute numbers of Bosmina greatly increased during this period. Species numbers were not reduced, but there were wife in relative shundares of cladoceran practics. Species numbers were not reduced, but there were shifts in relative abundances of cladoceran species. Bosmina longispina dominated all the lakes. Low pH (4.7) seemed not to be straight-forwardly harmful to Daphnia longispina, but the relative abundances of this taxon were reduced because of Bosmina. (Author's abstract) W88-08855

INTERACTIONS BETWEEN SEDIMENT CON-TAMINANTS AND BENTHIC ORGANISMS

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Regional Office.

T. B. Reynoldson. Hydrobiologia HYDRB8, Vol. 149, p 53-66, June 1987. 2 fig. 5 tab, 90 ref.

Effects Of Pollution-Group 5C

Descriptors: *Carcinogenesis, *Toxicity, *Water pollution effects, *Macroinvertebrates, *Bioaccumulation, *Path of pollutants, *Sediments, *Pollutants, *Benthos, *Biodegradation, Aquatic habitats, Trophic level, Literature review, Sediments.

Interactions between contaminated sediments and between contaminates addiments and benthic invertebrates in marine and freshwater sys-tems are reviewed using selected examples from the available literature. The most obvious impact on marine and freshwater invertebrates from contems are reviewed using selected examples from the available literature. The most obvious impact on marine and freshwater invertebrates from contaminated sediments is direct acute toxicity. Data also exist which suggest that contaminants may cause alterations in genetic structure or abertations in genetic expression in organisms such as Chironomidae and Oligochaeta. High rates of neoplasm have been identified in marine biota in association with urban discharges — e.g., blue mussels and Olympia oysters in Oregon, clams in Chesapeake Bay, and soft-shell clams in Maine. Changes in benthic invertebrate community structure resulting from sediment contamination may be directly-induced or may be mediated indirectly; for example, increased chironomid numbers in response to contamination by crude oil can be related to enhanced algal growth. Processes by which benthic organisms transfer contaminants from sediments to other components of the aquatic system include (1) bioaccumulation, which is restricted to uptake of contaminants via sediment ingestion; (2) trophic transfer, which is the movement of contaminants through the food web and the accompanying biomagnification effects; (3) migration, which incorporates the possible implications of spatial movement in which organisms move into and out of contaminanted sediment; (4) biodegradation, which is the effect that physical movement and alteration of the sediments (by organisms) may have on contaminants. The significance of these processes will have to be considered in any attempt to manage contaminants. The significance of these processes will have to be considered in any attempt to manage contaminants desiments (by organisms) may have on contaminants. The significance of these processes will have to be considered in any attempt to manage contaminants. The significance of these processes will have to be considered in any attempt to manage contaminants of sediments (by organisms) more into and out of the sediments (by organisms) and have to be considered in any attempt to between benthic invertebrates (and other organisms) and sediment materials. (Alexander-PTT) W88-08860

SEDIMENT-ASSOCIATED CONTAMINANTS AND LIVER DISEASES IN BOTTOM-DWELL-ING FISH, National Marine, Fisheries Service, Seattle, WA.

Northwest and Alaska Fisheries Center.

D. C. Malins, B. B. McCain, D. W. Brown, U.

D. C. Malins, B. B. McCain, D. W. Brown, C. Varanasi, and M. M. Krahn.
Hydrobiologia HYDRB8, Vol. 149, p 67-74, June 1987. 2 fig, 2 tab, 27 ref.

Descriptors: *Sediments, *Puget Sound, *Organic compounds, *Hydrocarbons, *Pollutants, *Fish diseases, *Liver, *Benthic fauna, *Water pollution effects, *Statistical methods, *Chlorinated hydrocarbons, *Bioaccumulation, Bioassay, Population exposure. Tissue analysis, Chromatography, Fish *Distriction.* physiology, Fish.

High concentrations of chemicals have been found in sediments from urban areas of Puget Sound. Hundreds of organic chemicals (including certain aromatic hydrocarbons (AHs) and various chlorin-Hundreus of organic elements including Certain aromatic hydrocarbons (AHs) and various chlorinated compounds) were indentified. Statistical methods were used to evaluate possible relationships between the chemistry data and fish diseases. Positive correlations were found between the frequencies of liver peoplesms (e.g., penatocellular quencies of liver neoplasms (e.g., hepatocellular carcinoma) and other liver lesions in English sole (Parophrys vetulus) and concentrations of AHs in (Parophrys vetulus) and concentrations of AHs in sediment; such correlations were not found with chlorinated hydrocarbons. Strong evidence was also obtained to show that many organic chemicals in sediment are bioavailable to bottom-dwelling fish. Stomach contents (consisting mainly of benthic invertebrates) from English sole had concentrations of a number of AHs similar to those in the sediment from which the fish were taken. In these same fish, metabolites of many aromatic com-

pounds were found in bile using a procedure com-bining high-performance liquid chromatography with fluorescence detection. Further, the concen-trations of certain xenobiotic metabolites in bile were correlated positively with the occurrence of liver neoplasms in English sole. (Author's abstract) W88-08861

USE OF BIOASSAY AND ASSOCIATED TESTS IN DREDGED MATERIAL AND DISPOSAL MANAGEMENT,

Corps of Engineers, Vicksburg, MS.
For primary bibliographic entry see Field 5A.

CONSEQUENCES OF ENVIRONMENTAL CONTAMINATION BY LEAD MINING IN

dford Univ. (England). School of Environmental Science

B. E. Davies. Hydrobiologia HYDRB8, Vol. 149, p 213-230, June 1987. 3 fig, 37 ref.

Descriptors: *Lead mining, *Wales, *Sediments, *Path of pollutants, *Water pollution sources, *Water pollution effects, *Heavy metals, *Envi-ronmental effects, *Contamination, *Mine wastes, *Bioaccumulation, *Biodegradation, Bioassay, Copper, Zinc.

Lead mining in Wales originated before the Roman Occupation. The main active period was from 1750-1900 when zinc and copper were also mined and during this period only simple and inefficient ore processing methods were available. Consequently large amounts of copper, lead and zinc compounds were lost to the environment and have since become incorporated in sediments and soils. Locally, pollution may still occur from drainage from abandoned mines and by mobilization of mine tailings. This paper describes the present state of Welsh rivers and reviews the distribution of contaminants in sediments and soils. The uptake of heavy metals by plants and the consequences for human health are also discussed. (Author's abstract) stract) W88-08868

OLIGOCHAETE RESPIRATION AS A MEAS-URE OF SEDIMENT TOXICITY IN PUGET SOUND, WASHINGTON,

For primary bibliographic entry see Field 5A. W88-08874

SUBLITTORAL AND PROFUNDAL OLIGO-CHAETA FAUNA OF THE LAKE CONSTANCE (BODENSEE-OBERSEE), Landesanstalt fuer Umweltschutz Baden-Wuert-temberg, Karlsruhe (Germany, F.R.). Inst. fuer Seenforschungs Fischereiwesen.

L. Probst. Hydrobiologia HYDRB8, Vol. 155, p 277-282, December 1987. 1 fig, 3 tab, 18 ref.

Descriptors: *Sediments, *Oligochaetes, *Lake Constance, *Eutrophication, *Water pollution effects, *Lakes, *Benthic fauna, *Annelids, *Limnology, *Species composition, *Decomposing organic matter, *Organic carbon, Model studies, Mathematical studies, Trophic level, Population dynamics, Cycling nutrients, Worms.

Fourteen tubificid species and one lumbriculid make up the oligochaete population of the northern half of Lake Constance, a meso-to mesocutrophic lake. Tubifex tubifex makes up 72% of the total abundance, the clean water species Stylodrilus heringianus only 0.1%. No correlation exists between total worm abundance and organic between total worm abundance and organic carbon content of the sediment, only 4% of the organic carbon being used by the worms. A highly significant correlation between particulate organic matter loading and its organic carbon content from 10 tributaries and total oligochaete abundance is demonstrated. The ecological index I sub PA is defined and used to assess the biologically relevant trophic status of the lake bed. This integrates infortion on the percent representation of three

groups of worm species classified on a trophic basis and total abundance of the worms. Despite control of the increase in phosphorus loadings progressive eutrophication of sediments was ob-served after an 8 year interval. (Author's abstract)

RAPID AND RELIABLE METHOD TO QUANTIFY ENVIRONMENTAL EFFECTS ON LAMINARIA BASED ON MEASUREMENTS OF ION LEAKAGE,

Goeteborg Univ. (Sweden). Dept. of Botany. For primary bibliographic entry see Field 5A. W88-08876

BENTHIC COMMUNITIES AND THEIR PHYSICAL ENVIRONMENT IN RELATION TO URBAN POLLUTION FROM THE CITY OF TROMSO, NORWAY: I. THE PHYSICAL ENVIRONMENT: HYDROGRAPHY, PLANT NUTRIENTS, ORGANIC ERRICHMENT, HEAVY METALS, AND REDOX CONDITIONS, Tromsoe Univ. (Norway). Dept. of Marine Biol-

B. Holte, K. J. Jakola, and B. Gulliksen. Sarsia SARIA3, Vol. 72, No. 2, p 125-132, 1986. 4 fig, 5 tab, 3 ref.

Descriptors: *Water pollution effects, *Benthic environment, *Industrial wastewater, *Wastewater disposal, *Industrial wastewater, *Wastewater disposal, *Municipal wastewater, *Marine environment, *Marine sediments, Norway, Heavy metals, Sedimentation, Plant nutrients, Organic enrichment, Ecology, Tidal effects, Tidal currents, Water currents, Redox conditions.

The extent of pollution in the marine environment The extent of pollution in the marine environment near the city of Tromso was investigated at seven selected sites from August 1979 to March 1981. Measurements of hydrographical factors (dissolved oxygen, salinity, temperature) and amounts of plant nutrients (orthophosphate, nitrate) did not indicate chronic marine pollution of the water masses near the city. This is probably due to strong ideal currents which proped sewage wastewater. masses near the city. This is probably due to strong tidal currents which spread sewage wastewater over large areas in a fairly short time. Rates of sedimentation of organic matter were relatively high near Tromso compared to localities about 15 km from the city. In situ redox measurements suggested a decrease in organic enrichment of the soft-bottom sediments with distance from the center of Tromso. A similar decrease was also observed in the concentrations of heavy sections. center of 1 romso. A similar decrease was also observed in the concentrations of heavy metals (mercury, cadmium, lead, zinc) in sedimenting material. The exposure of soft-bottom sediments to urban pollution is localized near the center of Tromso compared with the controls outside the city area. In general, only the sea bottom near the control of the property of th waste discharge-points is influenced by pollution from the city. (See also W88-08880) (Author's abstract) W88-08879

BENTHIC COMMUNITIES AND THEIR PHYSICAL ENVIRONMENT IN RELATION TO URBAN POLLUTION FROM THE CITY OF TROMSO, NORWAY: II. SOFT-BOTTOM COMMUNITIES,

Tromsoe Univ. (Norway). Dept. of Marine Biol-

B. Holte, and B. Gulliksen.
 Sarsia SARIA3, Vol. 72, No. 2, p 133-141, 1986. 9
 fig, 1 tab, 28 ref.

Descriptors: *Industrial wastewater, *Wastewater disposal, *Water pollution effects, *Benthic environment, *Municipal wastewater, *Marine environment, *Marine sediments, *Marine fauna, Species diversity, Tidal effects, Tidal currents, Water currents, Wastewater outfall. Heavy metals, Ecology, Norway, Sedimentation, Plant nutrients, Macrobenthos, Biomass.

Six sampling stations with relatively similar softbottom substrates and current regimes were inves-tigated to find out if there were qualitative and quantitative differences between the macrobenthos near the city of Tromso compared with that closer

Group 5C—Effects Of Pollution

to the open sea, and if possible faunal differences could be due to sewage from the city. Diversity was highest and dominance lowest at the sampling was ingrest and cominance lowest at the sampling stations furthest from Tromso (ca. 15 km), which were considered unaffected by pollution. The sam-pling stations nearest to the sewage outfalls were considered moderately exposed to pollution. Anal-ysis of similarity between the stations and log-normal distribution of practice for the stations. normal distributions of species/abundance supported these assumptions. Total biomass was an unsuitable variable for evaluating the effects of pollution, able variable for evaluating the effects of pollution, due to irregular occurrences of large bivalves and prosobranchs. When the 16 most frequent taxa were considered, the following ten, Nemertinea indet., Harmothoe imbricata, Eteone longa, Anaitides maculata, Typosyllis spp., Naineris quadricuspida, Spio filicornis, Polydora spp., Capitella capitata, and Hetermastus filiformis, showed a preference for either or both of the sampling stations nearest to the sewage outfalls. The sewage from the city had relatively small and local effects on the marine infauna, mainly due to the strong tidal water-exchange and mixing around the Tromso Island. (See also W88-08879) (Author's abstract) W88-08880

BIOCONCENTRATION OF HG203CL2 IN RAINBOW TROUT AND CARP AT LOW CON-

CENTRATIONS, Tokyo Metropolitan Research Inst. for Environ-Tokyo Metropointai Research Ind. 101 Earthon-mental Protection (Japan).

M. Wakabayashi, M. Kikuchi, Y. K. Oh, T. Yoshida, and H. Kojima.
Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No. 5, p 841-845, May 1987. 5 fig, 1 tab, 9 ref.

Descriptors: *Trout, *Carp, *Bioaccumulation, *Mercury, *Biological magnification, Toxicity, *Heavy metals, Rivers, Fish.

Rainbow trout (Salmo gairdneri) and carp (Cyprinus carpio) were exposed to Hg203Cl2 at a concentration of 0.5 micrograms Hg/l. At relativeconcentration of 0.5 micrograms Hg/l. At relatively short-term exposure, the mean bioconcentration
factor (BCF) of rainbow trout was affected by the
pH of the buffered exposure solution and was high
at low pH as compared with high pH. The BCF
for a 17 day exposure in the artificial water was
about 800 for rainbow trout and carp, but the
concentrations of Hg203 in fishes and in the solution were not in equilibrium. The profile of bioconcentration in the river water was similar to that in centration in the river water was similar to that in centration in the river water was similar to that in the artificial water. The equilibrium BCF estimated using a simple linear differential equation were several thousands. (Author's abstract) W88-08883

CHEMICAL CHARACTER OF BOTTOM SEDI-MENT AND THE BENTHIC BIOMASS IN ISE AND MIKAWA BAYS, Mic Univ., Tsu (Japan). Faculty of Fisheries. H. Iwasaki, J. Ishii, and S. Ueda. Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No.6, p 1065-1071, June 1987. 6 fig, 1 tab, 13 ref.

Descriptors: *Benthos, *Sediments, *Biomass, *Marine sediments, *Eutrophication, *Ise Bay, *Mikawa Bay, Organic matter, Chemical oxygen demand, Oxygen carbon, Nitrogen, Interstitial water, Sulfides, Shallow waters.

To obtain information on the threshold level of eutrophication inhibiting the reproduction of useful marine organisms in shallow waters, the relation between the organic matter content of bottom sediment and the benthic biomass was analyzed in Ise and Mikawa Bays. Of the benthic biomass, Polychaeta was dominant, and occurred in 39 species in Ise Bay, 75% in individuals, 14.4% in wet weight; in Mikawa Bay it was 40 species, 45.1% in individuals, 21.9% in wet weight. The benthos occurred densely at the mouth of both bays and at the east-side of Chita peninsula. In Ise Bay, the organic matter content of the sediment, ranging from 1.9 to 30.5 mg/g in TOC (total organic carbon), from 0.22 to 3.61 mg/g in TN (total introgen), was lower than that in neighboring bays. On the contrary, dissolved iron in the pore water of the sediment showed a remarkable high value, 0.4 mg/l in average. The ratio of C/N was also To obtain information on the threshold level of 0.4 mg/l in average. The ratio of C/N was also higher than in Mikawa Bay. Horizontal distribu-

tion of COD (chemical oxygen demand), TOC, and TN in the sediment was generally similar, and the organic matter content was the highest in the coastal area from Tsu to Matsusaka in Ise Bay, the inner parts of the west and the north of Mikawa Bay. High correlations (>==0.94) between COD. Bay. High correlations (57=0.59) between COB, TOC, and TN in the sediment, were observed. Benthos was the most abundant in a range of 3 to 8 mg/g of COD and became poor above 14 mg/g in total sulfide S content of the sediment. Apparently COD value, TOC, TN, and total sulfide S content were good indices of eutrophic level in shallow waters, and the threshold values for benthos were waters, and the threshold values for benthos were about 14 mg/g in COD value, corresponding to 15.6 mg/g in TOC, 1.65 mg/g in TN, and the total sulfide S content of 0.4 mg/g. (Author's abstract) W88-08885

STUDY ON THE SHAKING CULTURE METHOD TO EVALUATE THE EFFECT OF MUNICIPAL SEWAGE ON THE GROWTH OF PORPHYRA YEZOENSIS, (IN JAPANESE), Tokyo Univ. of Fisheries (Japan). For primary bibliographic entry see Field 5E. W88-08889

STUDIES OF THE SAMPLING TIME OF THE EFFLUENT OF THE MUNICIPAL SEWAGE TREATMENT PLANT TO EVALUATE THE EFFECTS ON THE GROWTH OF PORPHYRA YEZOENSIS, (IN JAPANESE), Tokyo Univ. of Fisheries (Japan). For primary bibliographic entry see Field 5E. W88-08890

IMPACT OF SUBLETHAL OIL AND EMUL-SION EXPOSURE ON THE REPRODUCTIVE SUCCESS OF LEACH'S STORM-PETRELS: SHORT AND LONG-TERM EFFECTS, Maine Univ. at Farmington. Dept. of Sciences and

R. G. Butler, A. Harfenist, F. A. Leighton, and D.

Journal of Applied Ecology JAPEAI, Vol. 25, No. 1, p 125-143, April 1988. 2 fig, 10 tab, 53 ref.

Descriptors: *Water pollution effects, *Waterfowl, *Oil pollution, *Animal behavior, *Toxicity, Crude oil, Oil dispersant emulsion, Leach's stormpetrels, Reproductive success.

The short- and long-term effects of sublethal expo-sure to crude oils or an oil-dispersant emulsion on the reproductive success of Leach's storm-petrels the reproductive success of Leach's storm-petrels (Oceanodroma leucorhoa Vieillot) were examined during a 3-year field study. Adult petrels were captured in their breeding burrows before and after the hatching period at a colony in Newfoundland, Canada. The birds were individually banded, assigned to either control or. experimental groups that received one of a variety of toxicant exposures, and then released back into their permanentially marked burrows. The reproductive success of sures, and then released back into their permanently marked burrows. The reproductive success of all study birds was monitored for the remainder of the breeding season, and the return rates and breeding performance of some groups were monitored during the second breeding following initial exposure. The results indicated that: (a) internal or external exposure of adult petrels to some sublethal doses of crude oils or emulsion significantly reduced hatching success and fledging success in a dose-dependent manner, (b) adult petrels were the most sensitive to contaminant exposure late in the incubation period and early in the post-hatching period, (c) pollutant-related decreases in reproductive success were probably associated with the period, (c) pollutant-related decreases in reproduc-tive success were probably associated with the temporary abandonment of the nesting burrow by the treated adult, and (d) treated adults generally exhibited normal return rates and breeding per-formance in the second season after exposure. (Au-thor's abstract) W88-08891

UPTAKE OF CADMIUM BY GAMMARUS FOSSARUM (AMPHIPODA) FROM FOOD AND WATER,

Basel Univ. (Switzerland). Botanisches Inst.
T. Abel, and F. Barlocher.
Journal of Applied Ecology JAPEAI, Vol. 25, No.

1, p 223-231, April 1988. 3 fig, 5 tab, 21 ref.

Descriptors: *Amphipods, *Gammarus, *Heavy metals, *Cadmium, *Water pollution effects, Soft water, Hard water, Food contamination, Toxicity.

Survival and cadmium accumulation of Gammarus Survival and cadmum accumulation of cammarus fossarum Koch were compared when the water or its food, conditioned oak leaves, were contaminated. In starving animals, LC50 values were 30-40 times lower in cadmium-contaminated soft water than in hard water. Final cadmium concentrations in dead animals were similar in both treatments.

Aquatic hyphomycetes, which occur on condi-tioned leaves, accumulated cadmium very rapidly and to high final concentrations. G. fossarum eating contaminated leaves suffered increased mor-tality and accumulated cadmium in its tissues. In soft water, direct effects of cadmium contamina-tion on G. fossarum were much more severe than indirect effects suffered through ingestion of con-taminated food. In hard water, uptake from water also had a more drastic effect than uptake through food, but the difference was less pronounced. The importance of contaminated food is probably highimportance or consumnated rood is probably high-est when cadmium pollution in streams occurs as a pulse too short to directly affect G. fossarum, but long enough to allow cadmium accumulation by fungion leaves. (Author's abstract)

GROWTH RESPONSES OF BIRCH AND SITKA SPRUCE EXPOSED TO ACIDIFIED RAIN.

Institute of Terrestrial Ecology, Bangor (Wales).

Bangor Research Station.
T. W. Ashenden, and S. A. Bell.
Environmental Pollution ENPOEK, Vol. 51, No.
2, p 153-162, 1988. 5 tab, 17 ref.

Descriptors: *Growth rates, *Acid rain, *Birch trees, *Spruce trees, *Conifers, *Deciduous trees, Seedlings, Leaves, Hydrogen ion concentration, Mortality, Soil types.

Mortality, Soil types.

Seedlings of birch and Sitka spruce were grown on a range of British soils for 2 years and exposed to simulated acid rainfall treatments of pHs 5.6, 4.5, 3.5 and 2.5. Both species developed visible leaf injury patterns when exposed to the pH 2.5 treatment. In Sitka spruce this leaf injury was followed by high needle loss during the first winter and greater mortality. Generally, height growth of Sitka spruce was unaffected by treatments, but acid rainfall at pH 2.5 increased the height of birch. Mean height of both species was strongly affected by soil type. The relationship of significant soils and treatment effects on the heights of both species indicated that on some soils plant growth responses to the treatments did not fit the general pattern. Hence, while the results indicate that generally ambient acidities of rainfall in the UK are unlikely abundance, plants growing on some soils may be susceptible to injury. (Author's abstract)

W88-08893 W88-08893

EFFECT OF EXTRACTS OBTAINED FROM OLIVE OIL MILL WASTE WATERS ON BACILLUS MEGATERIUM ATCC 33085,

Granada Univ. (Spain). Dept. of Microbiology. M. M. Rodriguez, J. Perez, A. Ramos-Cormenzana, and J. Martinez.

Journal of Applied Bacteriology JABAA4, Vol. 64, No. 3, p 219-226, March 1988. 7 fig, 3 tab, 38

Descriptors: *Water pollution effects, *Food-processing wastes, *Antibiotics, *Bactericides, *Wastewater composition, Olive oil, Alpechines, Industrial wastewaters.

n-Propanol was the most effective solvent for exintropants was the most effective solvent for extracting antibacterial substances from olive oil mill wastewater ('alpechines'). Several phenolics were detected in propanol extracts that had bactericidal effects on Bacillus megaterium ATCC 33085, inhibiting asporulation and germination at 5-6 mmol/ I total phenolics (expressed as syringic acid). The biological effect was increased in the presence of

Waste Treatment Processes—Group 5D

high glucose and NaCl concentrations and after beta-glucose hydrolysis. (Author's abstract)

COAL GAS PLANT WASTES: REMNANT OF

AN ERA,
BCM Engineers, Inc., Plymouth Meeting, PA,
For primary bibliographic entry see Field 5B.
W88-08901

5D. Waste Treatment Processes

OVERHAULING HEALTH EFFECTS PER-

Colorado Springs Dept. of Utilities, CO. For primary bibliographic entry see Field 5F. W88-08003

FIXED-FILM BIOLOGICAL NITRIFICATION OF A STRONG INDUSTRIAL WASTE,

OF A STRONG INDUSTRIAL WASTE, Clarkson Univ., Potsdam, NY. A. G. Collins, W. W. Clarkson, and M. Vrona. Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 4, p 499-504, April 1988. 3 fig, 3 tab, 23 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Industrial wastewater, *Ni-trification, Fixed-film nitrification, Fluorides, Pilot plants, Semiconductor manufacturing, Contact sta-

Biological nitrification is one alternative unit operation considered for pretreatment of waste streams produced by the semiconductor manufacturing industry. Results of rotating biological contactor pilot plant studies in which wastewaters with high ammonia concentrations alone and combined with ammona concentrations and early commend with high fluoride concentrations are presented. Fluo-ride adversely affects nitrification efficiency and process stability. In the absence of fluorides, nitrifi-cation rates eight times higher than typically rec-ommended were achieved. (Author's abstract)

ROLE OF GAC ACTIVITY AND PARTICLE SIZE DURING THE FLUIDIZED-BED ANAER-OBIC TREATMENT OF REFINERY SOUR WATER STRIPPER BOTTOMS, Renord, Inc., Milwaukee, WI. Corporate Research and Development Group. D. A. Gardner, M. T. Suidan, and H. A.

Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 4, p 505-513, April 1988. 9 fig, 9 tab, 12 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Industrialized waste, *Adsorbents, *Industrial wastewater, *Activated carbon, *Fluidized bed process, *Anaerobic digestion, *Particle size, Refinery sour water, Performance relateries, *Toxicalized process.* ance evaluation. Toxicity.

Three expanded-bed anaerobic reactors were operated in parallel on sour water stripper bottoms. Two sizes of granular activated carbon (GAC) and Two sizes of granular activated carbon (GAC) and non-activated carbon were used in the reactors. Performance was evaluated. The adsorptive capacity of GAC was essential for reducing the toxicity of the wastewater, thus permitting uninhibited biological treatment. Reactor performance improved with decreasing GAC particle size and when higher loading rates of the wastewater were used. This was attributed to the increased surface available for microbial attachment and the decreased diffusional resistance to adsorption that accompany a decrease in GAC particle size. (Author's abstract) stract) W88-08007

DIGESTER GAS H2S CONTROL USING IRON

SALIS, San Jose Dept. of Water Pollution Control, CA. P. Dezham, E. Rosenblum, and D. Jenkins. Journal Water Pollution Control Federation JWPFAS, Vol. 60, No. 4, p 514-517, April 1988. 3

fig, 3 tab, 7 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Anaerobic digestion, *Digester gas, *Hydrogen sulfide, *Iron compounds, Sludge digestion, Vivianite, Sedimentation basins, Scaling.

A satisfactory method for control of H2S concentrations in digester gas was achieved by determing a FeCl2 dose added to digester sludge feed lines. Vivianite scale formation was avoided in digester appurtenances. Information is presented on the iron salt dose required to control digester on the iron sait dose required to control algester gas H2S at different levels, and a discussion is included on the theoretical basis for the use of iron salts for this purpose. The effects of iron salts on primary sedimentation basin performance are also discussed, as well as techniques for preventing vivianite scale. (Author's abstract)

FATE AND EFFECT OF METHYLENE CHLORIDE AND FORMALDEHYDE IN METHANE

RIDE AND FORMALDEHYDE IN METHANE FERMENTATION SYSTEMS, Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
S. J. Bhattacharya, and G. F. Parkin.
Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 4, p 531-536, April 1988. 6 fig. 7 tab, 13 ref. National Science Foundation, Grant No. CEE-83-00687.

Descriptors: *Wastewater treatment, hyde, *Methylene chloride, wastewater treatment, *Anaerobic Methane bacteria, *Fermentation, Chlorinated hydrocarbons, Organic compounds, Acetate, Propionate, Enrichment, Effluents, Retention time, Methane, Biodegradation, Microbial degradation.

Anaerobic chemostats were used to study fate and kinetic effects of slug and continuous additions of formaldehyde and methylene chloride to acetate and propionate enrichment systems. Much higher concentrations of formaldehyde and methylene chloride could be tolerated when added continuous ously. With continuous additions of formaldehyde and methylene chloride, new steady states were attained with higher effluent propionate and ace-tate concentrations, or both. The effects of different solids retention times (SRT) were clearly seen. Lower SRTs showed higher effluent volatile acids concentrations with continuous addition. Both toxicants affected the acetate-utilizing methanogens more than the propionate-utilizers under similar conditions. Biodegradation was the major formaldehyde and methylene chloride removal mechanism. (Authors abstract)
W88-88010

COMPARISON OF THE GRAPHICAL AND STANDARD METHODS FOR THE DETERMI-NATION OF BIOCHEMICAL OXYGEN

Houston Univ., TX. Environmental Engineering Program.

For primary bibliographic entry see Field 5A. W88-08011

MODELING THE PERFORMANCE OF DEEP

MODELING THE PERFORMANCE OF DEEP WASTE STABILIZATION PONDS,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
M. D. Moreno, M. A. Medina, J. Moreno, A. Soler, and J. Saez.
Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 377-387, April 1988. 7 fig. 5 tab, 22 ref.

Descriptors: *Wastewater treatment, *Stabilization ponds, Waste disposal, Model studies, Pollution load, Mathematical studies, Prediction, Biomass, Phytoplankton, Nutrients, Climate, Effluents, Tracers, Performance evaluation, Bacteria, Dissolved oxygen.

The performance characteristics of a deep waste stabilization pond operating in Southeast Spain were studied for one year; the results show a high reduction in organic load and nutrients, as well as

disinfection of the effluent, after a retention time that varies as a function of climatic conditions.

Mathematical models describing its hydraulic, thermal, and biochemical behavior are presented and compared with a set of measured data. These two models are not coupled, assuming that the changes in biomass concentration do not affect significantly the degree of heat executive in the changes in the changes of heat executive in the changes in the changes of heat executive in the changes in the changes of heat executive in the changes in the changes of heat executive in the changes in the changes of heat executive in the changes in biomass concentration do not affect significantly the degree of heat penetration into the water column. The thermal submodel predicts vertical homothermy throughout the year, in agreement with the observed data. The biochemical model simulated the variations in phytoplankton, bacterial biomass, dissolved oxygen and nutrients as a function of temperature (from the thermal submodel run independently), meteorological data, and influent characteristics (measured). The results from both models are compared to field data. The tests for differences between means and variances are used to compare computed and measured values, showing an excellent agreement. The higher variability in the observations as opposed to predicted alkalimity values suggests that some precipitation processes linked to the higher Pd valued uning the summer should also be included in the model. (Alexander-PTT)
W88-08045

POTENTIAL AVAILABILITY OF ANAEROBIC TREATMENT WITH DIGESTER SLURRY OF ANIMAL WASTE FOR THE RECLAMATION OF ACID MINE WATER CONTAINING SULFATE AND HEAVY METALS,

Yamagata Univ. (Japan). Lab. of Applied Microbi-

K. Ueki, K. Kotaka, K. Itoh, and A. Ueki. Journal of Fermentation Technology JFTED8, Vol. 66, No. 1, p 43-50, February 1988. 7 fig. 2 tab,

Descriptors: *Wastewater treatment, *Digestion, *Anaerobic digestion, *Slurries, *Animal wastes, "Annani wastes, "Mastewater renovation, "Re-claimed water, "Acid mine drainage, "Sulfates, "Heavy metals, Alkalinity, Hydrogen ion concen-tration, Chemical precipitation.

The use of an anaerobic digester slurry of cattle waste for the reclamation of acid mine water was examined. When the digester slurry was mixed with acid mine water, anaerobic digestion, including sulfate reduction and methanogenesis, was enhanced. In the mixture of acid mine water and the digester slurry sulfate reduction proceeded with digester slurry, sulfate reduction proceeded with-out diminishing methanogenesis. The digester slurry and its supernatant showed a significant capacity to act as a strong alkaline reagent, and the pH of the acid mine water was markedly elevated by the addition of the digester slurry or superna-tant even at the low ratio of 1% by volume. Precipitation of heavy metals in the acid mine water occurred as the pH was elevated by the addition of supernstant. When the digester slurry was added at the ratio of 5% by volume to acid mine water which had been pretreated with super-natant, the rate of sulfate reduction increased with natant, the rate or suntate reduction increased with increasing the concentration of sulfate in the mixture up to about 1400 mg/liter. In acid mine water pretreated with supernatant and supplemented with the digester slurry at the ratio of 5% by volume, the maximum amount of sulfate reduced within 20 days of incubation was about 1000 mg/ liter, and the maximum rate of sulfate reduction was about 120 mg sulfate/liter/day. (Author's abstract) W88-08131

INFLUENCE OF PH ON METHANE AND SULFIDE PRODUCTION FROM METHANOL,

Shimizu Construction Co. Ltd., Tokyo (Japan). Inst. of Tech.

K. Minami, Y. Tanimoto, M. Tasaki, S. Ogawa, and K. Okamura.

Journal of Fermentation Technology JFTED8, Vol. 66, No. 1, p 117-121, February 1988. 2 fig. 2 tab. 12 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Fermentation, *Methane, *Sulfides, *Methanol, *Sulfates, *Sulfur com-

Group 5D—Waste Treatment Processes

pounds, *Hydrogen ion concentration, Pumice stone, Methanogenesis.

To investigate the influence of pH on methane and To investigate the influence of pH on methane and sulfide production, continuous cultures were done using a bio-reactor packed with pumice stone. Sulfate in a methanol-defined medium was almost completely reduced to sulfide at pHs between 7.0 and 7.5 in methane fermentation, but at pHs between 6.2 and 6.8 sulfate reduction to sulfide was suppressed up to 40%. In addition, methane fermentation was not inhibited by 10 g sulfate/liter. (Author's abstract)
W88-08132

NEW COMPOSITE CHARGED REVERSE OS-MOSIS MEMBRANE, Nitto Electric Co. Ltd., Osaka (Japan). For primary bibliographic entry see Field 3A. W88-08137

ACIDIC WASTEWATER TREATMENT BY DONNAN DIALYSIS INVOLVING TUBULAR ANION-EXCHANGE MEMBRANES, Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering. G. Wisniewska, and T. Winnicki. Desalination DSLNAH, Vol. 68, No. 2-3, p 121-130, March 1988. 6 fig, 6 ref.

Descriptors: *Wastewater treatment, *Membrane processes, *Membranes, *Acidic water, *Dialysis, *Ion exchange, *Anion exchange, Chemical wastewater, Selectivity, Nitrates, Sulfates, Salts, Nitrocellulose.

Tubular anion-exchange membranes were employed in an attempt to remove nitrate and sulfate ions from acidic wastewaters. Unlike the investigations accomplished earlier, this study makes use of actual acidic wastewaters (effluent from the rinsing actuar acidic wastewaters (effluent from the rinsing of nitrocellulose) to test the usefulness of the title membranes as applied to the separation of nitrate ions and sulfate ions. The effect of the type and concentration of the hydroxide solution on the course of the dialysis process (i.e. on the desired.) course of the dialysis process (i.e., on the deacidifi-cation rate and on the selectivity of the process) is investigated. Consideration is also given to the relationship between the presence of salts in the concentrate and the efficiency of dialysis. (Author's abstract) W88-08138

SUBSTITUTION OF THE FINAL CLARIFIER BY MEMBRANE FILTRATION WITHIN THE ACTIVATED SLUDGE PROCESS WITH IN-CREASED PRESSURE: INITIAL FINDINGS, Stuttgart Univ. (Germany, F.R.). Inst. fuer Sied-lungswasserbau, Wasserguete- und Abfallwirtslungswasserbau, chaft.

Charles K. Krauth, and K. F. Staab.

Desalination DSLNAH, Vol. 68, No. 2-3, p 179-189, March 1988. 11 fig, 9 tab, 9 ref.

Descriptors: *Wastewater treatment, *Filtration, *Membrane filters, *Solid-liquid separation, *Clari-fiers, *Activated sludge, Biodegradation, Sludge digestion, Oxygenation, Pressure.

The Institut fuer Siedlungswasserbau, Wasserguette- und Abfallwirtschaft of the University of Stuttgart has performed a series of tests with the activated sludge process at increased pressures over a long period. The advantage of this process is that it increases the activated sludge content by improving the oxygen supply. This advantage is accompanied by a decrease in the production of excess sludge as an additional benefit. A major disadvantage of this process is the fact that the separation of the activated sludge from the water has to be done at the same pressure as that applied has to be done at the same pressure as that applied to the biological reactor as a result of the choice for a continuous operation, This fact leads to technical difficulties. Tests carried out with membranes in another research project suggested that membrane filtration could be effective for solid/liquid separation. The initial findings clearly confirmed this, even though the testing conditions were not optimal. (Author's abstract)
W88-08139

ELIMINATION OF SURFACTANTS BY PRE-CIPITATION/FLOCCULATION (ELIMINA-TION VON TENSIDEN DURCH FAELLUNG/ FLOCKUNG), M. Kolb, D. Grau, and B. Funke.

Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 3, p 82-85, June 1987. 4

Descriptors: *Ions, *Precipitation, *Wastewater treatment, *Chemical treatment, *Surfactants, *Chemical precipitation, *Flocculation, Iron compounds, Calcium hydroxides, Textile mill wastes, Freundich equation, Langmuir equation, Mathematical studies, Hydrogen ion concentration.

The elimination of anionic and nonionic surfactants by precipitation/flocculation with Fe(III)/Ca(OH)2 and Fe(II)/Ca(OH)2 was investigated. The elimination of anionic surfactants followed the Freundlich equation. At a pH of 8 and initial surfactant concentration of 10 milligrams per liter the elimination amounts to only 10%, but at a pH of 6 to 40% (Fe(III)/Ca(OH)2). With increasing surfactant concentration the alimination also surfactant concentration the elimination also be-comes greater. The elimination of nonionic surfaccomes greater. In elimination of nonionic surfac-tants can be described by the Langmuir equation. At an initial concentration of I milligram per liter the elimination amounts to 20%, with decreasing pH the elimination decreases slightly. Precipita-tion/flocculation experiments with Fe(II)/ Ca(OH)2 showed a significantly higher elimination in comparison with Fe(III)/Ca(OH)2. As before, in comparison with Fc(III)/Ca(OH)2. As before, however, the elimination of anionic surfactants followed the Freundlich equation and elimination of nonionic surfactants could be described by the Langmuir equation. Both surfactants were eliminated to a higher degree (up to 50%) when carrying out the experiments with original textile wastewater. (Author's abstract)
W88-08146

PROCESS CONSIDERATIONS IN BIOLOGICAL TREATMENT OF LOW CONCENTRATION WASTEWATERS: I. STEADY STATE, Minnesota Univ., Minneapolis. Dept. of Civil and

Mineral Engineering.

W. J. Maier, G. M. Klecka, and R. E. Bailey.

Zeitschrift fuer Wasser- und Abwasser-Forschung

ZWABAQ, Vol. 20, No. 3, p 85-90, June 1987. 5

fig, 2 tab, 25 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Industrial wastes, Sub-strates, Optimization, Process control, Organic

Process performance of well-mixed continuous-flow reactors treating low-concentration industrial wastewaters has been modeled to study the effects of reactor sizing and configuration. The study fo-cuses on achieving high levels of treatment (94-% removal). It is shown that reactor staging is necessary and much more effective than increasing resi-dence time of a single-stage continuous-flow reac-tor. The effects of endogenous decay of cell mass have been incorporated and show that there is an optimum residence time. At long residence time, the rate of endogenous decay becomes the controling factor that determines overall efficiency of substrate removal. (See also W88-08149) (Author's abstract) W88-08147

PROCESS CONSIDERATIONS IN BIOLOGICAL TREATMENT OF LOW CONCENTRATION WASTEWATERS: II. DYNAMICS,

Minnesota Univ., Minneapolis. Dept. of Civil and Minneral Engineering.
W. J. Maier, G. M. Klecka, and R. E. Bailey.
Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 108-112, August 1987. 7 fig, 2 tab, 11 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Sludge, *Activated sludge, Mathematical models, Biomass, Substrates, Process control, Design criteria.

The performance of activated-sludge-type treatent systems operating at non-steady-state condi-

tions has been analyzed using mathematical models. The results show that the inventory of active biomass is a rate-limiting factor when the system is stressed by imposing higher flows or feed concentration. The magnitude and duration of changes in substrate-removal efficiency have been characterized for a series of imposed changes in flow rate and feed concentration. Practical implications concerning the development of more affecting the concentration. cations concerning the development of more effective process-control strategies are discussed. (See also W88-08148) (Author's abstract) W88-08149

VOLTAMMETRIC DETERMINATION OF MERCURY IN A SEWAGE SLUDGE SAMPLE, Fachhochschule Aachen (Germany, F.R.). For primary bibliographic entry see Field 7B.

EFFECTS OF INTERMITTENT LACK OF OXYGEN ON BIOLOGICAL TREATMENT OF

Kemijski Inst. Boris Kidric, Ljubljana (Yugoslav-

M. Ros, M. Toman, and M. Dular. Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 21, No. 1, p 11-15, February 1988. 1 fig, 14 tab, 12 ref.

Descriptors: *Biological wastewater treatment, *Acrobic treatment, *Wastewater treatment, *Ac-tivated sludge process, *Bacteria, Biocenosis, Aer-ating equipment, Electrical malfunction.

An intermittent lack of oxygen can occur in the aerators of biological treatment plants for a variety of reasons, most frequently malfunctions of aerating equipment or the lack of electricity. The effects of a 24-hour lack of oxygen in the aerator with simultaneous discontinuance of waste water inflow on both biocenosis of activated sludge and on treatment effect was investigated. For municipal wastewater, the only noticeable effect of an interruption of aeration, was a minimal uptake of oxygen; the average temperature of the test model was lower than that of the comparative model. For industrial wastewater, oxygen uptake was also industrial wastewater, oxygen uptake was also inwas lower than that of the comparative model. For industrial wastewater, oxygen uptake was also increased, the number of bacteria increased, and the number of organisms of biocenosis concomitantly decreased. It is concluded that an interruption of aeration (for 24 hr or less) does not perturb the system provided the inflow of wastewater is also interrupted. (Brock-PTT)

W88-08171

REMOVAL OF PHOSPHORUS DURING WASTEWATER TREATMENT: A REVIEW, Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering. S. Yeoman, T. Stephenson, J. N. Lester, and R. Perry.

Environmental Pollution EPEBD7, Vol. 49, No. 3, p 183-233, 1988. 7 fig, 5 tab, 264 ref.

Descriptors: *Phosphorus removal, *Nutrient removal, "Wastewater treatment, "Biological wastewater treatment, "Reviews, "Chemical treatment, Calcium, Iron, Aluminum, Coagulation, Optimization, Bacteria, Sewage bacteria

The removal of phosphorus from wastewater is reviewed. Phosphorus removal may be accomplished by chemical or advanced biological treatment, or by a combination of both. Chemical removal involves the addition of calcium, iron, and aluminum salts to precipitate phosphorus by various mechanisms, which are discussed. The effects ous mechanisms, which are discussed. The effects of operating conditions are reviewed, including wastewater characteristics, sludge production in terms of quality and quantity, optimization of chemical use and reuse, and points of chemical addition combined with biological treatment. Alternative chemical/physical treatments and examples of full-scale applications are also reviewed. Biological phosphorus removal, which depends on the uptake of phosphorus in excess of normal bacterial metabolic requirements, is proposed as an alternative to chemical treatment. Early develop-

Waste Treatment Processes—Group 5D

ments and the postulated removal mechanisms are reviewed. These include natural chemical precipi-tation, enhanced biological removal, or a combinatation, enhanced biological removal, or a combina-tion of both. The nature of excess biological phos-phorus removal in activated sludge wastewater treatment plants is evaluated, considering various operating factors, bacteriology, and process design. (Author's abstract) W88-08198

DECOLORIZATION OF MOLASSES WASTE WATER BY A THERMOPHILIC STRAIN, AS-PERGILLUS FUMIGATUS G-2-6. Tsukuba Univ. (Japan). Inst. of Applied Biochem-

stry.

S. Ohmomo, Y. Kaneko, S. Sirianuntapiboon, P. Somchai, and P. Atthasampunna.
Agricultural and Biological Chemistry ABCHA, Vol. 51, No. 12, p 3339-3346, December, 1987. 6 fig, 3 tab, 14 ref.

Descriptors: *Color removal, *Wastewater treatment, *Biological wastewater treatment, *Soil fungi, *Industrial wastes, *Fermentation, Optical properties, Fungi, Culture media, Tropic zone, Climatic zones.

Soil samples from Bangkok were screened for fungi that can decolorize molasses melanoidin in the tropical zone. Some strains were isolated, mainly in the genus Aspergillus. Of these, strain No. G-2-6 was most active and was identical to Aspergillus fumigatus based on detailed morphological studies. This strain decolorized about 75% of a molasses melanoidin solution when cultivated on a glycerol-peptone medium at 45 C for 3 days with shaking. In successive decolorization reusing the mycelia, this strain had more than 60% of the melanoidin-decolorizing activity at the eighth replacement in the presence of 4% glycerol. Continuous decolorization of molasses melanoidin solution in a jar fermentor had an almost constant decolorization yield of about 70% at a dilution rate of 0.014/hr. At the same time, about 51% of the chemical oxygen demand and 56% of the total organic carbon in the initial solution were removed. In contrast, continuous decolorization of organic carbon in the initial solution were re-moved. In contrast, continuous decolorization of non-dialyzed molasses melanoidin solution re-moved a little more chemical oxygen demand and total organic carbon than those of dialyzed molas-ses melanoidin solution, but had a lower level of melanoidin-decolorizing activity (about 40%). (Author's abstract) W88-08204

IMPROVEMENT IN AEROBIC SLUDGE DI-GESTION THROUGH PH CONTROL: INITIAL ASSESSMENT OF PILOT-SCALE STUDIES, British Columbia Univ., Vancouver. Dept. of Civil eering For primary W88-08208 bibliographic entry see Field 5E.

TREES AND SHRUBS FOR CONTROL OF TANNERY WASTEWATER IN INDIA, Conservator of Forests, Research and Develop-ment, Lucknow (India). For primary bibliographic entry see Field 5E. W88-08213

INFESTATION BY AQUATIC WEEDS OF THE FERN GENUS SALVINIA: ITS STATUS AND

CONTROL,
Centre for Water Resources Development and Management, Kunnamangalam (India). Water Quality and Environment Div.
For primary bibliographic entry see Field 4A. W88-08214

DEVELOPMENT OF WATER REUSE IN ISRAEL, Hebrew Univ. of Jerusalem (Israel). For primary bibliographic entry see Field 3C. W88-08225

GROWTH INHIBITION OF BACILLUS SUBTI-LIS BY BASIC DYES.

Gifu Univ. (Japan). Dept. of Chemistry. T. Ogawa, M. Shibata, C. Yatome, and E. Idaka. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 4, p 545-552, April 1988. 6 fig. 1 ab, 16 ref.

Descriptors: *Bacteria, *Population growth, *Growth inhibition, *Dyes, *Dye toxicity, *Wastewater treatment, *Water pollution effects, *Bacillus, *Bacterial physiology, *Growth rate, *Alkalinity, *Wastewater, *Activated sludge, Population studies, Triphenylmethane dyes, Toxicity studies, Japan.

Dyeing at factories is usually carried out in con-junction with desizing, scouring and finishing. The total drainage thus contains many water-soluble organic substances. Since these are not adequately organic substances. Since trees are not accusately eliminated by physical treatment, the water is purified in many cases by biological treatment such as the activated sludge method. However, dyes, bichromates, etc., present in the water often cause growth inhibition of microbes and make purification more difficult. Dye toxicity has been frequently tratified with seasons to consideration. ly studied with respect to sterilization and muta-tion for medical application, but not much in regard to water-treatment. The influence of basic dyes on the growth rate and nucleic acid content of cells was investigated in the present study to elucidate inhibitive reactions in the biological treatment of waste dye-liquor. (Author's abstract) W88-08257

ADSORPTION OF CARCINOGENIC BENZ(A)PYRENE ON ACTIVATED SLUDGES, Perugia Univ. (Italy). Cattedra di Igiene. For primary bibliographic entry see Field 5B. W88-08298

REMOVAL OF NICKEL (II) FROM WATER USING DECAYING LEAVES: EFFECTS OF PH AND TYPE OF LEAVES,

Al-Najah National Univ., Nablus (Jordan). Dept. of Chemistry. For primary bibliographic entry see Field 5G. W88-08299

REMOVAL OF COLOR FROM WASTEWATER BY SORPTION FOR WATER REUSE, Banaras Hindu Univ., Varanasi (India). Inst. of

G.S. Gupta, G. Prasad, and V. N. Singh. Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 3, p 205-217, April 1988. 8 fig, 3 tab, 17 ref.

Descriptors: *Toxic wastes, *Wastewater treatment, *Water reuse, *Color removal, Chrome dye, Sortion, Kinetics, Temperature, Model studies, Mathematical model.

The removal of Metomega Chrome Orange GL, a commercial textile dye from wastewaters has been found to be nearly 99% under optimal conditions using fly ash as a sorbent. The process follows a first order kinetics. Intraparticle diffusion and mass transfer coefficients have been determined at different temperatures. The sorption data fit well into the Langmuir isotherm model. The effect of temperature has been explained on the basis of boundary. perature has been explained on the basis of boundary layer thickness, activation energy and enthalpy change. Heat of sorption has been found to be a function of surface coverage. (Author's abstract) W88-08300

DIFFUSIONAL LIMITATIONS OF ANAERO-BIC BIOFILMS,

National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.

K. J. Kennedy, and R. L. Droste. Canadian Journal of Civil Engineering CJCEB8, Vol. 14, No. 5, p 631-637, October 1987. 8 fig, 1

Descriptors: *Wastewater treatment, *Filtration, *Degradation, *Bacteria, *Biofilms, Anaerobic digestion, Metabolism, Diffusion, Kinetics, Thiele Using an empirical determination of apparent kinetic parameters in the bulk mixed liquor, the intrinsic kinetic parameters of anaerobic biofilms developed at 35 C during start-up and steady-state downflow stationary fixed film reactor operation were estimated. The apparent kinetic parameters of anaerobic biofilms are not significantly influenced by internal diffusion limitations. The apparent kinetic parameters of mature biofilms showed no significant trends with increased biofilm thickness up to 2.6 mm and increased apparent Thiele modulus up to 3.1. (Author's abstract) lus up to 3.1. (Author's abstract) W88-08304

EFFECT OF SEWAGE-SLUDGE ON THE HEAVY METAL CONTENT OF SOILS AND

PLANT TISSUE, Nova Scotia Agricultural Coll., Truro. For primary bibliographic entry see Field 5E. W88-08372

SOLID WASTE HANDBOOK: A PRACTICAL

For primary bibliographic entry see Field 5E. W88-08387

BIOLOGICAL PROCESSES, Department of Energy, Washington, DC. Office Energy from Municipal Waste. D. K. Walter, J. L. Easterly, and E. C. Saris. IN: The Solid Waste Handbook: A Practical Guide. John Wiley and Sons, New York. 1986. p 749-769, 2 fig, 4 tab, 35 ref, 2 append.

Descriptors: *Biological treatment, *Wastewater treatment, Anaerobic digestion, Fermentation, Biomass, Fuel, Composting, Electricity.

Comprehensive examination of the several active Comprehensive examination of the several active processes describes anaerobic digestion (gaseous fuels), fermentation processes (liquid fuels), and composting (humus and solids), including design parameters, systems and equipment, feedstocks, products, and operations. Also included is a study of himmer as fuel for produced least initial to the contract of the cont of biomass as a fuel to produce electricity in the United States by region, biomass fuel type (wood, agricultural landfill, gas, and municipal solid waste), and total kilowatts produced from each type. (Author's abstract) W88-08389

TRACE METAL REMOVAL FROM AQUEOUS

Royal Society of Chemistry, London (England). Royal Society of Chemistry, London (Lengand), The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as a part of the Annual Chemical Con-gress, University of Warwick, April 9-10, 1986. The Royal Society of Chemistry, London. Special Publication No. 61, 1986. 245 p. Edited by R.

Descriptors: *Trace metals, *Wastewater treat-ment, *Symposium, Chemical precipitation, Chem-ical reactions, Lime, Chemical treatment, Ion exchange, Resins, Biological treatment, Chemical

Increasing industrialization brings with it the twin problems of more thorough removal of unwanted and possibly toxic metals from chemical and nuclear process effluent, and the need to obtain some metals from progressively leaner initial sources or dilute recycle fiquor. Legislation and economics link the two, but whatever the motivation the chemical principles are the same. Traditional methods such as precipitation by liming competation. chemical principles are the same. I radinolal meti-ods, such as precipitation by liming, cementation or electrodeposition, become less effective as metal ion concentrations fall to the low parts per million range and large volumes of liquor need to be handled. Resort may be made to ion-exchange and solvent extraction procedures, but resin degrada-tion and autopositive to the same add to the month. solvein extraction procedures, but ream legitada-tion and evaporation losses can add to the prob-lems of an unattractively high proportion of aque-ous phase. Alternative methods based on biological systems, with the complexation abilities of large molecules, the use of novel membranes and selec-tive precipitants which overcome previous solubili-

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ty product barriers are constantly under developty product barriers are constantly under develop-ment. A symposium reviewing progress in these fields was considered a fitting contribution by the Industrial Division to the Royal Society of Chem-istry's 1986 Annual Congress. The papers present-ed, including two on analytical techniques now available for metal determination at trace levels, are reproduced here together with a subsequently contributed item on carbon adsorption techniques for gold recovery. (See W88-08399 thru W88-08407) (Lantz-PTT) W88-08399

RECOVERY OF HEAVY METALS BY IMMO-

BILIZED ALGAE, New Mexico State Univ., Las Cruces. Dept. of

Chemistry
D. W. Darnall, B. Greene, H. Hosea, R. A.
McPherson, and M. Henzl.
IN: Trace Metal Removal from Aqueous Solution.
The Proceedings of a Symposium Organized by
the Industrial Division of the Royal Society of
Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986.
The Royal Society of Chemistry, London. Special
Publication No. 61, 1986. p 1-24, 13 fig, 1 tab, 24

Descriptors: *Heavy metals, *Algae, *Wastewater treatment, *Biological treatment, Hydrogen ion concentration, Ion exchange resins, Costs, Mine astes, Ion exchange, Ions

A number of studies have investigated the feasibility of using actively growing algae in ponds or lagoons for wastewater treatment. The basic approach has been to flow polluted waters through a lagoon in which an algal bloom is present. The effluent waters from such a system are then found to have lowered heavy metal ion concentrations. The algae-silica matrix functions as a 'biological,' mixed-bed ion exchange resin. Like ion exchange resins, the algae-silica material can be recycled. Metal ions have been sorbed and stripped over a smany as 30 cycles with no noticeable loss in efficiency. In contrast to some ion exchange resins, advantages of the algae-silica matrix include: (1) the compounds of hard water (Ca(2+), Mg(2+)) or monovalent cations (Na(+), K(+)) do not spificantly interfere with the binding of toxic, heavy metal ions; (2) It can be used, under certain conditions, to remove a variety of heavy metals from metal ions; (2) It can be used, under certain condi-tions, to remove a variety of heavy metals from solutions, and then these metal ions can be selec-tively stripped from the matrix. Because certain metal ions are bound with different affinities de-pending upon the pH of the medium only a pH gradient is needed in the regeneration cycle in order to separate metal ions; and (3) An additional advantage of the algae-silica system is that the material costs should be more than competitive with those associated with an ion exchange system. Thus the use of the algae-silica technology for wastewater treatment and for treatment of mining process streams appears to offer an attractive alterprocess streams appears to offer an attractive alternative for various industries. (See also W88-08398) (Lantz-PTT) W88-08399

USE OF GRAM-POSITIVE BACTERIA FOR THE REMOVAL OF METALS FROM AQUE-OUS SOLUTION, Newcastle upon Tyne Univ. (England). Dept. of

Microbiology I. C. Hancock

I. C. Hancock.

IN: Trace Metal Removal from Aqueous Solution.

The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986.

The Royal Society of Chemistry, London. Special Publication No. 61, 1986. p 25-43, 5 fig. 5 tab, 38

Descriptors: *Wastewater treatment, *Bacteria, *Metals, *Biological treatment, *Metal complexes, Bacterial analysis, Leaching, Chemical reactions, Toxicity, Biological studies, Chemical reactions.

The use of bacteria, such as Thiobacillus, in metal leaching operations has received a great deal of study and a good theoretical basis has been estab-

lished for the role of the microorganisms in the process. Although the use of microorganisms for accumulating metal ions from aqueous salt solutions has also been investigated by, many research groups, much of the work has been largely empirical, involving blanket screening of microorganisms for the recovery of specific metals, particularly gold, silver and radionuclides arising from nuclear processing. Thus, microorganisms as disparate as Gram-positive bacteria of the genus Streptomyces, the Gram-negative bacteria Pseudomonas, the green algae Chlorella, and the fungus Rhizopus has been reported to have particular advantages for the recovery of uranyl ions. If microbes are to be used in high technology processes for the recovery of precious metals, the removal of toxic heavy metals, or the purification of materials for processes such as electrolytic metal recovery, more detail than just what cell components are involved in metal jon binding, where they are located in the cell, the chemical nature of the complexation and the way it may be controlled or modulated, is needed. Requirements for a good microbial metal binding system are: (1) Microbes remain viable under operating conditions; (2) Microbes have high 'extracellular' binding capacity; (3) Binding must be effective over a wide range of pH values; (4) Binding must exhibit high selectivity for the metal ion of choice; (5) The microorganisms must be cheap to grow and recover; and (6) Recovery of metal ions must be easy and avoid lysis of the microbe. (See also W88-08398) (Lantz-PTT) lished for the role of the microorganisms in the must be easy and avoid lysis of the microbe. (See also W88-08398) (Lantz-PTT) W88-08400

NEW GENERATION OF SOLID-STATE METAL COMPLEXING MATERIALS: MODELS AND INSIGHTS DERIVED FROM BIOLOGICAL SYSTEMS, Devoe-Holbein Technology B.V., The Hague

(Netherlands).

(Netherlands).

1. W. DeVoe, and B. E. Holbein.

IN: Trace Metal Removal from Aqueous Solution.

The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986.

The Royal Society of Chemistry, London. Special Publication No. 61, 1986. p 58-70, 6 fig, 8 tab, 16

Descriptors: "Metals, "Metal complexes, "Model studies, "Wastewater treatment, Water quality control, Synthetic compounds, Hazardous wastes, Chemical treatment, Industrial wastes.

The increasing public awareness of the hazards present in industrial liquid, solid, and gaseous waste emissions puts an ever-increasing pressure on nuclear and non-nuclear industries to conform to safe environmental standards. Some metal emis-sions in gaseous and aqueous effluents from nuclear sions in gaseous and aqueous effluents from nuclear industries pose special problems for which conventional technology provides virtually no solution. A new technology, initially patterned after the highly efficient metal handling capabilities of biological systems, has progressed from the laboratory to industrial applications. This technology, the heart of which is a series of metal-capturing synthetic compositions, has application to nuclear waste, toxic waste and metal processing. Special features of these compositions include: (1) Selectivity - for target metals or groups of metals; (2) Regenerability - regeneration cycle can be accomplished in 1.0-4.0 bed volumes with metal concentration in 1.0-4.0 bed volumes with metal concentration; (3) Conservation - conditioners and regenerants. reaching or exceeding 50,000 ppm off the column; (3) Conservation - conditioners and regenerants can be reused requiring only occasional supplementation; (4) Physical stability - no swelling or shrinking at extreme pH ranges or from heat; and (5) Volume reduction - due to selectivity, volume reduction of metals can be orders of magnitude greater than ion exchangers. Target metals can be removed from water to levels that meet worldwide environmental standards. (See also W88-0838) (Janzz-PTT) 08398) (Lantz-PTT) W88-08402

ION TRANSFER BY SOLID-SUPPORTED LIQUID MEMBRANES,

Minnesota Univ., Minneapolis. Dept. of Chemistry. M. M. Kreevoy.

IN: Trace Metal Removal from Aqueous Solution. The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986. The Royal Society of Chemistry, London. Special Publication No. 61, 1986. p 90-108, 3 fig, 18 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Ion exchange, *Supported liquid membranes, *Ion transfer, Chemical treatment, Chemical reactions, Membranes, Stripping, Ions.

Extraction of ions, accompanied by chemical reac-tion or exchange of ionic partners, is an old tech-nique, widely practiced in industry and in analyti-cal chemistry, and sometimes called liquid ion ex-change. This sort of solvent extraction is discussed car chemistry, and sometimes called inqual one exchange. This sort of solvent extraction is discussed in considerable detail because its chemistry is identical with that of liquid membranes. It is now technically possible to replace mixer-settlers of conventional solvent extraction with a membrane, fabricated by filling the pores of a thin, porous, plastic support with the same sort of water-insoluble solutions. The feed is circulated past one face of the membrane, where extraction occurs (the loading face); the target-carrier complex diffuses across the membrane; and stripping takes place at the other face (the stripping face), past which the strippant circulates. The nominal pore sizes of the membranes are, typically, 0.02-0.2 microns, but some of the supports in use actually appear, under magnification, to be masses of fibers, rather than a continuous material with pores. Capillary forces hold the organic film is only 20-100 micron thick, the residence time of the ions of interest is usually only a few migrates and the active reservant is promothy organic film is only 20-100 micron thick, the residence time of the ions of interest is usually only a few minutes, and the active reagent is promptly reused, so the reagent requirements is reduced by many orders of magnitude, compared to conventional extraction. The most likely candidates for treatment using supported liquid membranes, are separations in which a small amount of target ion must be removed from a large volume of aqueous solution, either because it is valuable, or because its presence degrades the value of the stream. Because the success of a supported liquid membrane separation depends on a number of factors interacting in a complicated way, engineering development can a complicated way, engineering development can benefit a great deal from basic studies, which can now be rationally organized. (See also W88-08398) W88-08403

METAL REMOVAL USING COORDINATING COPOLYMERS,

Reading Univ. (England). Dept. of Chemistry. M. J. Hudson.

M. J. Hudson.

The Trace Metal Removal from Aqueous Solution.

The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986. The Royal Society of Chemistry, London. Special Publication No. 61, 1986. p 137-156, 7 fig, 2 tab, 54

Descriptors: *Wastewater treatment, *Metals, *Polymers, *Copolymers, Hazardous wastes, Chemical treatment, Radionuclides, Chemical reactions, Chemical properties.

Coordinating copolymers are also known as selective ion exchangers. They are polymers in which ligands are covalently bound to a central chain or matrix. The term coordinating copolymers is frequently used for synthetic, insoluble, organic-based macromolecules. In addition to the functional group on the polymer, it is necessary to consider the nature of the polymer chain (e.g., hydrophobicity, degree of crosslinking). The chemistry of the metal in the natricular anneous environment also is city, degree of crosslinking). The chemistry of the metal in the particular aqueous environment also is important. Coordinating copolymers are used in a wide variety of processes for the recovery of metals from aqueous and non-aqueous solution. The principal areas of use are in the recovery of toxic and precious metals, particularly from dilute solution. They may also be used for the recovery of radionuclides from liquid nuclear effluent. (See also W88-08398) (Lantz-PTT)

Waste Treatment Processes—Group 5D

CONTROL OF HEAVY METAL DISCHARGE WITH SODIUM BOROHYDRIDE, Morton Thiokol, Inc., Danver, MA. Ventron Div. J. A. Ulman.

J. A. Ulman.

IN: Trace Metal Removal from Aqueous Solution.

The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986. The Royal Society of Chemistry, London. Special Publication No. 61, 1986. p 173-196, 3 fig, 11 ref.

Descriptors: *Heavy metals, *Wastewater treat-ment, *Sodium borohydride, Water pollution pre-vention, Industrial wastes, Industrial wastewater.

Since its synthesis approximately 40 years ago, sodium borohydride has been shown to be a powerful and versatile reducing agent in numerous industrial processes. Its effectiveness in reducing metal cations has led to its application in the following areas: (1) removal of metals from waste streams to meet strict discharge limits; (2) autocalaytic (electroless) plating of metals such as nickel, copper, and gold on a wide variety of substrates; (3) recovery of precious metals from waste streams; and (4) preparation of catalytic metal species used in the hydrogenation of organic compounds. This paper reviews the use of sodium borohydride (NaBH4) for the removal and recovery of metal contaminants from industrial waste bombydride (NaBH4) for the removal and recovery of metal contaminants from industrial waste streams. Results of this research and development program to develop and implement effective processes for the removal of metals from metal finishing effluents are described in detail. Particular attention is focused on: (1) laboratory development of procedures for removing copper from printed wire board (PWB) industry waste solutions, and (2) scaleup and implementation of these procedures at industrial waste treatment facilities. The benefits foreseen for this system have been realized in both continuous treatment system at this and other facilities, and in batch treatment systems. Copper (and other metals) concentrations have been reduced, in most chelated solutions, to low levels, allowing compliance with environmental agency duced, in most chelated solutions, to low levels, allowing compliance with environmental agency regulations. The all-liquid system can be operated automatically with ORP control. Sludge volume reductions vs. conventional treatment methods have been significant. This allows for increased production rates and results in considerable savings in sludge disposal costs. And, because of their favorable characteristics, these sludges are being accepted by a refiner, thereby minimizing the waste treater's liability for hazardous waste disposal. (See also W88-08398) (Lantz-PTT) W88-08406

MECHANISM OF PHOTOLYTIC OZONA-

TION,
SumX Corp., Austin, TX.
G. R. Peyton, and W. H. Glaze.
IN: Photochemistry of Environmental Aquatic
Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p
76-88, 6 fig. 1 tab, 36 ref.

Descriptors: *Ozonation, *Wastewater treatment, *Organic compounds, Photolysis, Chemical properties, Hydrogen ion concentration.

Photolytic ozonation has been known for over a decade as a powerful water treatment process for the destruction of organic compounds, but its mode of action has not been understood. It is mode of action has not been understood. It is shown using kinetic arguments and data from scav-enging experiments that photolysis of aqueous ozone yields hydrogen peroxide, which then reacts with further ozone in a complex series of reactions to yield hydroxyl radicals. The proposed mecha-nism is shown to explain the pH behavior of model compound destruction seen in practicus studies compound destruction seen in previous studies. (See also W88-08526) (Author's abstract) W88-08531

PHOTOCATALYSIS BY INORGANIC COMPONENTS OF NATURAL WATER SYSTEMS,

Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.

ECONOMICAL PROCESS FOR ADVANCED WASTEWATER TREATMENT,

Robert and Co., Atlanta, GA.
J. K. Shepherd.
Public Works PUWOAH, Vol. 119, No. 4, p 41-44,

Descriptors: *Wastewater treatment, *Sludge disposal, *Biological wastewater treatment, *Chemical wastewater treatment. Phosphorus removal, Denitrification, Nitrification, Sludge, Georgia,

The expansion of the Northeast Water Pollution Control Facility, in Clayton County (Georgia) is described. The facility was expanded from 0.8 mgd to 4.0 mgd capacity. This required upgrading to advanced wastewater treatment limitations of 10 mg per 1 BOD, 1.5 mg per 1 ammonia, 1.0 mg per 1 phosphorus, and 6.0 mg per 1 dissolved oxygen. Sludge composting, restricted to enclosed vessel type systems to maximize process control and min-Sludge composting, restricted to enclosed vessel type systems to maximize process control and minimize odor, was chosen as the sludge disposal concept. A non-proprietary biological nutrient removal process of denitrification-nitrification was chosen for wastewater treatment. The short operating period since final completion of the composting system has not been sufficient for detailed evaluation. There is enough data, however, to evaluate the liquid portion of the system. In the 13 months since operations stabilized in April 1986. evaluate the liquid portion of the system. In the 13 months since operations stabilized, in April 1986, flow averaged 2.3 mgd with a maximum of 5.2 mgd. Average influent contained 149 mg per 1 BOD;127 mg per 1 SS; 16.6 mg per 1 NH4; 25.8 mg per 1 total nitrogen; and 8.8 mg per 1 phosphorus. The BOD to phosphorus ratio was 16.6:1. Excluding the composting facility, the final construction cost was approximately \$1.13 per gallon. (Roseman-PTT) man-PTT)

OPERATOR'S GUIDE TO WASTEWATER VI-

RUSES, Williamsport Sanitary Authority, PA. Wastewater

M. H. Gerardi, A. P. Maczuga, and M. C.

Zimmerman. Public Works PUWOAH, Vol. 119, No. 4, p 50-52, April 1988, 2 tab, 9 ref.

Descriptors: *Wastewater workers, *Viruses, *Wastewater treatment, *Personnel, *Workers, *Occupational exposure, Population exposure, Epidemiology, Disinfection, Wastewater, Diseases, Human disease, Public health.

Due to their daily contact with sewage, wastewater personnel have potentially a high incidence of exposure to enteric viruses. Although aerobic and anaerobic wastewater treatment processes significantly reduce the number of viruses in wastewater and sludges, these processes do not eliminate their number. Wastewater treatment processes that produce large quantities of aerosols also represent potential sources of viral transmission. Wastewater viruses are transmitted by fecal contamination and infect an individual through the contamination and infect an individual through intestinal mucosa (ingestion: fecal-oral route) or respiratory mucosa (direct inhalation of aerosols). Transmission can also occur via mechanical vectors (i.e., flies). The major methods of wastewater disinfection are considered and compared and lists of viral groups of concern to wastewater personnel are given. (Roseman-PTT)
W88-08550

ENERGY PRODUCTION THROUGH THE TREATMENT OF WASTES BY MICRO-ORGA-

TREATMENT OF WARD NISMS,
Agricultural and Food Research Council, Norwich (England). Norwich Lab.
D. B. Archer, and L. A. Thompson.

Journal of Applied Bacteriology Symposium Sup-plement JABAA4, Vol. 63, p 59S-70S. 1987. 3 fig., 4 tab., 83 ref.

Descriptors: *Wastewater treatment, *Energy sources, *Methane, *Ethanol, *Hydrogen, *Fuel, *Biological wastewater treatment, Microorga-nisms, Bacteria, Yeast, Microbiological studies, Economic aspects.

The production of methane, hydrogen, and ethanol from wastes is considered. Various methods of waste conversion and the microorganisms involved waste conversion and the microorganisms involved in the process are reviewed, and the economic aspects are considered. The production of methane and ethanol from wastes already proceeds on an industrial scale. A wide variety of wastes are con-vertible microbiologically to methane whereas ethvertible microbiologically to methane whereas ethanol production is restricted in the range of wastes used. Hydrogen production is not yet an industrial proposition from any waste; waste conversion to hydrogen is unlikely to favorably compare with the production of methane or ethanol. The economic success of the process does not depend solely on the value of the fuel produced. Prevention of pollution by a waste has a financial incention expected with it and may, in the long term, become an even more important factor. (Roseman-PTT) PTT) W88-08556

USE OF MODEL COMPOUNDS TO ELUCIDATE METAL FORMS IN SEWAGE SLUDGE, Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
T. Rudd, J. A. Campbell, and J. N. Lester. Environmental Pollution EPEBD7, Vol. 50, No. 3, p 225-242, 1988. 4 fig. 6 tab, 29 ref.

Descriptors: *Heavy metals, *Sludge, *Cadmium, Copper, Nickel, Zinc, Chemical extraction, Frac-tionation profiles, Wastewater pollution, Pollut-ants, Wastewater, Lead, Carbonates, Sulfides,

Model phases of metal precipitates and organically bound metal were used to corroborate the nature of metal species found in sewage sludge by a sequential chemical extraction scheme. Model phase extractions supported the identification of major species of Cd and Ni as carbonate (EDTA extractable), zinc as organically-bound (Na4P2O7 extractable), and lead as organically-bound or carbonate, although considerable overlap of fractions was apparent. Identification of the major species of Cu as sulfide (HNO3 extractable) could not be confirmed. The selectivity and efficiency of certain confirmed. The selectivity and efficiency of certain reagents was found to differ when used in sequence with other reagents, as opposed to be ap-plied individually to model metal phases. Sample preparation was found to influence metal fractiona-tion profiles in a model organic phase. (Author's

LEAD REMOVAL FROM WASTEWATER BY CEMENTATION UTILIZING A FIXED BED OF IRON SPHERES,

Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
T. Agelidis, K. Fytianos, G. Vasilikiotis, and D.

akoudakis Environmental Pollution EPEBD7, Vol. 50, No. 3, p 243-251, 1988. 2 fig, 4 tab, 17 ref.

Descriptors: *Lead, *Heavy metals, *Wastewater treatment, Wastewater, Industrial wastewater, Contact beds, Iron spheres, Wastewater pollution, Ions, Cementation, Wastewater, Pollutants.

A lead-ion cementation system was investigated using an iron-sphere packed bed. The extent of lead removal and excess iron consumption in similead removal and excess tron consumption in similar conditions to those of lead-bearing wastewater was determined experimentally. Determinations were made for packed spheres of several diameters, beds of different lengths, and different flow conditions. The experimental data were compared by means of rate coefficients and were correlated with empirical equations. The efficiency of lead removal was tested using wastewater from the manufacture of storage batteries. (Author's abstract) stract) W88-08567

BIOLOGICAL TREATABILITY OF IN SITU COAL GASIFICATION WASTEWATER,

Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.

Group 5D—Waste Treatment Processes

C. W. Bryant, C. C. Cawein, and P. H. King. Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 400-414, April 1988. 3 fig, 9 tab, 19 ref. 1 append

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Gasification, *Coal gasification, *Organic carbon, *Ammonia, Coal, Fuel, Chemical oxygen demand, Aerobic treatment, Biological treatment, Activated sludge, Sludge.

Wastewater from an underground coal-gasification (UCG) pilot facility was degraded aerobically in laboratory chemostats for a period of seven months. Pretreatment included only dilution and phosphorous addition. The experimental design included solids retention times from 10 to 30 days and dilution rates of 25% and 50%. Aerobic biocluded solids retention times from 10 to 30 days and dilution rates of 25% and 50%. Aerobic biologic treatment provided removal of 83-91% COD, 82-90% TOC, and 56-87% ammonia. The results extend the range of UCG wastewater strength to be effectively treated by biological processes. Air stripping is not a significant mechanism for carbon removal, but is estimated to have removed from 0% to 68% of the ammonia, depending upon operating conditions. The suitability of attached growth systems for treatment of this wastewater is indicated by: (1) Solids settling properties that would require very long clarification times in a full-scale activated sludge system; and (2) the enhanced COD removal filamentous organisms in one reactor. (Author's abstract)

GAS TRANSFER KINETICS IN OXYGEN ACTI-

GAS TRANSFER KINETICS IN OXYGEN ACTI-VATED SLUDGE,
Arkansas State Univ., State University. Dept. of
Civil Engineering.
R. C. Clifft, and M. W. Barnett.
Journal of Environmental Engineering JOEDDU,
Vol.114, No. 2, p 415-432, April 1988. 5 fig. 3 tab,
11 ref, 1 append.

Descriptors: *Wastewater treatment, *Sludge, *Activated sludge, *Gas transfer kinetics, *Mathe-matical models, *Model studies, Oxygen, Carbon dioxide, Nitrogen, Oxygen transfer rate, Prediction, Performance evaluation

The validity of a dynamic model based on the twofilm theory is examined for predicting gas transfer in an oxygen system using surface mixers. Model predictions are compared to field measurements in an oxygen system using surface mixers. Moder predictions are compared to field measurements taken from a four-stage, closed-tank carbonaceous reactor at the City of Houston, Texas, 69th Street Complex. A liquid film limited model was effective in prediction gas and liquid phase composition although direct interfacial transfer increased the overall oxygen transfer rate. DO predictions were best when using a linear relationship between the overall gas transfer rate coefficient for oxygen and the oxygen uptake rate. Carbon dioxide and nitrogen levels were adequately predicted using con-stant values for the overall gas transfer rate coeffi-cient, but the model was not sensitive to changes above 50% of the estimated overall gas transfer rate coefficient values. Leaks through the crack in the concrete tank cover had little effect on the gas phase composition in the first two aboves. the concrete tank cover had little effect on the gas phase composition in the first two phases, howev-er, fourth stage leaks and intentional venting result-ed in increased oxygen levels as nitrogen was displaced from the gas phase. Carbon dioxide levels were not appreciably affected by leaks or venting. (Author's abstract) W88-08577

ODORS FROM DISSOLVED AIR FLOTATION

National Univ. of Singapore. Dept. of Civil Engineering. L.C. Koe, and Y. G. Tan.

Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 433-443, April 1988. 4 fig, 6 tab,

Descriptors: *Wastewater treatment, *Wastewater treatment facilities, *Air pollution, *Pollutant identification, *Odors, *Dissolved air flotation, Toluene, Metaxylenes, Orthoxylenes, Phenol, Dimethyl sulfides, Alkyl benzenes, Chlorinated hydrocarbons, Organoleptic properties, Activated carbon,

Gas chromatography, Mass spectroscopy, Dynamic olfactometry.

The complex mixture of gaseous compounds di-rectly above the dissolved air flotation unit of a wastewater treatment plant was simultaneously scrubbed through four filter columns, each filled scrubbed through four inter columns, each miled with a commercial grade of activated carbon, until odor breakthrough as determined by an odor panel has occurred. Air samples were collected at the influent and effluent ports of the activated carbon columns for analysis on a gas chromatograph-mass spectrometer system and for determination of odor. spectrometer system and for determination of odor levels by dynamic olfactory. The capacity of each activated carbon grade for removing the odor emitted at the dissolved air flotation unit is then evaluated. Compounds which may cause odor in the dissolved air flotation air are identified to be toluene, meta, and orthoxylenes, phenol, dimethyl sulfides, alkyl benzenes, and chlorinated hydrocarbons such as chlorobenzenes. These compounds are effectively removed by activated carbon. Or accolenic tests reviewal that the edge of concentrations. are effectively removed by activated carbon. Organoleptic tests reveal that the odor concentrations of the odorous dissolved air floatation air averaged about 35 standard odor units (SOU) per cu m. The capacity of the activated carbon tested ranges from about 2,650 SOU per kg to 13,960 SOU per kg. The alkali-impregnated carbons are found to be less effective than the nonalkali-impregnated carbons in the treatment of odorous gases from the dissolved air floatation unit, even though previous research has shown them to be most effective when hydrogen sulfide and other sulfides are present in the off-gas stream. (Author's abstract) W88-08578

ESTIMATING SUPERNATANT RECYCLE FROM SLUDGE TREATMENT,
Tokyo Univ. (Japan). Dept. of Urban Engineering. V. Arun, and B. N. Lohani.
Journal of Environmental Engineering JOEDDU,
Vol.114, No. 2, p 447-453, April 1988. 1 fig, 3 tab,

Descriptors: *Biological wastewater treatment, *Computer simulations, *Wastewater treatment, *Sludge, *Supernatant recycle, *Mathematical "Computer simulations, "Wastewater treatment, 'Sludge, "Supernatant recycle, "Mathematical studies, "Simulation analysis, Statistical analysis, Wastewater facilities, Design criteria, Optimiza-tion, Activated sludge process, Rotating biological contactors, Trickling filters, Aerated lagoons.

Studies in the past have neglected the effects of recycled supernatant when using optimization techniques for choosing the best design from numerous alternatives. This can lead to serious errors in optimization and faulty selection of the "best" in optimization and faulty selection of the best design. The approach described here, which would enable incorporation of the recycle to any optimi-zation technique, was developed as part of a treat-ment plant optimization study. The recycled super-natant stream is rarely analyzed on a regular basis in operating plants, so, computer simulations, as presented here, can be useful for obtaining data for regression analysis and development of useful equations. Simulation were conducted for three different values of each of the influent parameters: flow, biochemical oxygen demand (BOD), and susflow, biochemical oxygen demand (BOD), and suspended solids concentration (SS). Four biological wastewater treatment systems were considered: Activated Sludge, Trickling Filter, Rotating Biological Contactor, and Aerated lagoon. Recycle flow relationships for all four systems had very high R squared and adjusted R squared values greater than 0.85, indicating a relationship between recycle supernatant flow (QR) and plant influent flow (QI). This type of simulation may be used to obtain data for QR, BOD, and SS for given influent conditions and for a unit process configuration. Statistical analysis which yields equations relating influent and recycle parameters, for a set of sludge processes, enables incorporation of optimization techniques. (Roseman-PTT)

STRATEGIES TO CONTROL COMBINED SEWER OVERFLOWS, Quebec Univ., Montreal. Dept. de Chemie. P. Beron, J. Rousselle, and J. P. Riley. Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 454-459, April 1988. 2 fig, 5 ref, 1

Descriptors: *Control systems, *Sewer systems, *Combined sewer Overflow, *Wastewater, *Storm runoff, *Storm sewers, *Urban runoff, *Design criteria, *Mathematical models, *Simulation analysis, Rainfall-runoff relationship, Hydraulic capacity, Overflow, Watersheds, Biochemical oxygen demand, Nitrogen, Orthophosphates, Suspended solids, Pollution load, Storms, Algorithms, Hydrographs, Pollutographs.

The relative effectiveness of various algorithms for overflow management were compared by their abilities to minimize impacts on the receiving streams. Five specific strategies were examined and compared: (1) Simple local control, (2) Local Automatic Control, (3) Centralized Volume Control, (4) Centralized Loads Control, (5) Centralized Weighted Loads Control. The area studied was a 5,100 hectare (13,000 acre) urban watershed with a consulation of 332 000 that is served mainly by 5,100 hectare (13,000 acre) urban watershed with a population of 332,000 that is served mainly by combined sewers. Hydrographs and pollutographs in the collector lines were simulated in order to assess the state of the system upstream from the points of control. One of the previously defined control algorithms or strategies was then applied and the impact on the receiving stream computed. Four quality parameters of the combined sewer overflow (CSO) are considered: 5-day biochemical oxygen demand, suspended solids, organi nitrogen level, and phosphorus (orthophosphate) level. For both interceptor designs considered the most effective control strategy is local automatic control, followed by centralized weighted loads control. Local simple control was the least effective strategy with both interceptor designs. (Roseman-PTT) gy with both interceptor designs. (Rosen W88-08580

DISPOSAL OF SEPTIC TANK EFFLUENT IN CALCAREOUS SANDS,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Organization, Wei Animal Production.

Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 272-277, April-June 1988. 8 fig, 2 tab,

Descriptors: *Water pollution sources, *Wastewater treatment, *Septic tanks, *Sand, *Calcareous soils, Soil chemistry, Effluents, Perth, Australia, Phosphorus, Nitrates, Carbonates, Leachates, Acidic water.

Perth, Western Australia, has 430,000 households Perth, Western Australia, has 430,000 households with septic tanks discharging through sandy soils into the groundwater, which is pumped for domestic irrigation and public water supply. This study investigated the suitability of calcareous sands (Xeropsamment), one of Perth's major soil types, for treatment of septic tank effluent. Calcareous sands adjacent and below two typical household sentits the fasterner, were served to a death of 8 m sands adjacent and below two typical nousehold septic tank systems were sampled to a depth of 8 m and the soil pH, soil N, and soil P contents were measured. The soil solution was sampled by an immiscible displacement technique and analyzed for N and P. Most of the ammonium-N in the effluent was oxidized to nitrate-N in the unsaturated zone just below the slime layer. Nitrate was present in the soil solution up to a concentration of 50 mg/liter down to the maximum depth sampled of 8 m. The acidity produced during nitrification of the ammonium dissolved carbonates from the of the ammonium dissolved carbonates from the soil, changing the soil pH. Below one system, the carbonates were completely removed from the first 4 m of soil, lowering soil pH from 9.5 to 5.2. The intrate in the soil solution was used to monitor the effluent flow pattern, which below one system had significant lateral flow, indicating development of preferred flow paths. The soil P was increased by sorption and precipitation of P from the soil solution until it reached an equilibrium. At equilibrium the soil solution P was at the same concentration as in the effluent, and the P sorbed on the soil was at a maximum for that concentration. Further down in the critical, and the P soroed on the soil was at a maximum for that concentration. Further down the profile where the sorbed soil P was not at its maximum, all the P was sorbed from the soil solution in a vertical distance of 0.5 m. The suitability of calcareous sands and limestone areas for acidic waste disposal may be limited by rapid

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dissolution of carbonate and the consequent release of previously sorbed P. Monitoring of effluent disposal in these calcareous soils is made more difficult by the development of preferred flow paths. (Author's abstract) W88-08760

CHEMICAL AND DECOMPOSITION CHARACTERISTICS OF ANAEROBIC DIGESTER EFFLUENTS APPLIED TO SOIL, Southeast Kansas Branch Experiment Station, Par-

D. W. Sweeney, and D. A. Graetz. Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 309-313, April-June 1988. 2 fig, 4 tab,

Descriptors: *Wastewater treatment, *Fate of pol-lutants, *Anaerobic digestion, *Land disposal, *Ef-fluents, Soil amendments, Industrial wastewater, Distillery wastes, Animal wastes, Swine wastes, Digestion, Molasses effluent.

A study was conducted to determine the elemental concentrations of an effluent that resulted from the anaerobic digestion of rum distillery by-product (also called molasses residue) and decomposition characteristics in soil as measured by CO2 evolucharacteristics in soil as measured by CO2 evolu-tion. For comparison, two additional effluents from the anaerobic digestion of swine wastes and bovine wastes were included. The carbon content of oven-dry molasses residue and swine waste ef-fluents were both approximately 250 g/kg, where-as the bovine waste was 152 g/kg. The molasses residue effluent sample had a greater K concentra-tion on an oven-dry basis than the swine or bovine waste materials. However, the concentrations of most other elements were higher in the swine most other elements were higher in the swine waste effluent. In contrast, higher solute concentrations were found for most elements in the molas-ses residue effluent than in the swine waste effluses residue effluent than in the swine waste effluent. An analysis of variance performed on total CO2-C evolved after 20 days as well as at the end of the experiment (117 days) indicated an interaction between effluent source and rate. This was caused by the low amount of CO2 evolved from soil amended with the bovine waste effluent regardless of application rate. At day 20, cumulative CO2 evolution was higher with the molasses residue effluent than with the swine waste effluent. however, by day 117, only at the high application rate was CO2 evolution higher with the molasses residue. Lower application rates allow for proportionally more short-term decomposition of the motionany more sourcettin decomposition of the mo-lasses residue and swine waste effluents than at higher rates. Although effluent sources result in different amounts of total evolution, between 40 and 50R of the total CO2 evolved may occur in the first 20 days. (Author's abstract)

CHARACTERIZATION OF AEROBIC, FACULTATIVE ANAEROBIC, AND ANAEROBIC BACTERIA IN AN ACIDOGENIC PHASE REACTOR AND THEIR METABOLITE FORMA-

Orange Free State Univ., Bloemfontein (South

Orange Free State Univ., Bloemfortein (South Africa), Dept. of Microbiology. W. A. Joubert, and T. J. Britz. Microbial Ecology MCBEBU, Vol. 13, No. 2, p 159-168, 1987. 3 fig, 29 ref.

Descriptors: *Bacteria, *Aerobic bacteria, *Anaerobic bacteria, *Digestion, *Wastewater treatment, *Biotransformation, *Anaerobic digestion, *Aerobic digestion, *Microbiological studies, Degrada-tion, Sokol and Michener's similarity coefficient, Culture studies, Acidogenic phase digestion sys-

Fifty-two aerobic and facultative anaerobic and 57 anaerobic bacterial isolates were obtained from an acidogenic phase digestion system. These isolates were characterized and the similarities between the different strains were calculated using Sokal and Michener's similarity coefficient. The aerobic and Michener's similarity coefficient. The aerobic and facultative anaerobic strains clustered in two major groups with the strains of the first main group being gram-negative fermentative rods represent-ing the genera Klebsiella, Enterobacter, Escheri-chia and Aeromonas. Isolates of the second group

were gram-positive streptococci similar to Strepto-coccus lactis. The strict anaerobic isolates were clustered into two main groups with strains of cluster A being identified as members of the genus Fusobacterium while strains in cluster B were members of the genus Bacteroides. Hypothetical mean organisms were calculated for each cluster and used in further culture studies. The major reducts of the continuous features independent. and used in further culture studies. The major products of the continuously fed acidogenic phase reactor were ethanol and acetic, propionic, and butyric acids. In batch cultures, ethanol, acetic acid, diacetyl and 2,3-butanediol were formed by the strains as major products both under aerobic and anaerobic conditions. The ability of the aerobic and facultative anaerobic strains to be metabolically active under anaerobic conditions indicates a prominent role in acidogenic reactors. (Author's abstract) abstract) W88-08787

ISOLATION OF NOSTOC MUSCORUM CYAN-OPHAGES FROM A DOMESTIC SEWAGE, Kuwait Univ., Safat. Dept. of Botany and Microbi-

ology.
A. J. Sallal, N. D. Nimr, and H. F. Al-Sharif.
Microbial Ecology MCBEBU, Vol. 13, No. 3, p
269-271, 1987. 5 fig, 3 tab, 12 ref.

Descriptors: *Wastewater, *Isolation, *Nostoc, *Bacteria, *Wastewater treatment, *Seasonal variation, Kuwait, Cyanophages, Cyanobacteria.

Two Nostoc muscorum cyanophages were isolated from a domestic sewage in Kuwait. N-1L cyanophage had a hexagonal head with a long tail, while N-2S cyanophage was a short-tailed virus. N-1L cyanophage was active at 50 degrees and at acidic pH while N-2S was more heat stable and active at pH 7.0. Seasonal variations in the total number of plaque-forming units of N. muscorum cyanophages were determined for sewage samples collected at each treatment step. (Author's abstract)

MICROBIALLY MEDIATED GROWTH SUP-PRESSION AND DEATH OF SALMONELLA IN COMPOSTED SEWAGE SLUDGE, Agricultural Research Service, Beltsville, MD. Soil-Microbial System Lab. P. D. Millner, K. E. Powers, N. K. Enkiri, and W.

P. D. Burge.
D. Burge.
Microbial Ecology MCBEBU, Vol. 14, No. 3, p 255-265, 1987. 4 tab, 16 ref. EPA Interagency Agreement AD12-F-2a-029.

Descriptors: *Salmonella, *Wastewater treatment, *Sewage bacteria, *Bacteria, *Microbiological studies, *Compost, *Coliforms, *Sludge, Fungi, Growth suppression, Wastewater.

The role of compost microflora in the suppression of salmonella regrowth in composted sewage sludge was investigated. Microbial inhibition studies of salmonella growth were conducted on nutrient agar, in composts that had been subjected to different temperatures in compost piles, and in radiation sterilized composts inoculated with selected fractions of the compost microflora. Agar assays of inhibition indicated that bacteria and actinomycetes were not suppressive to salmonelly to salmonelly. assays of inhibition indicated that bacteria and actinomycetes were not suppressive to salmonellae, but a few fungi were. However, compost inoculation assays showed consistently that fungi were not suppressive, but bacteria and actinomycetes were. In compost inoculation assays, microbial antagonists, when present, either killed salmonellae or reduced their growth rate. No suppression of salmonellae occurred in compost taken from 70 C compost-pile zones despite the presence and growth of many types of microbes. With greater numbers and kinds of microbes in 55 C compost, salmonella growth was suppressed [100-10.000-fold. numbers and kinds of microbes in 55 C compost, salmonella growth was suppressed 100-10,000-fold. Salmonellae died when inoculated into compost from unheated zones (25-40 C) of piles. Prior colonization of compost with only noncoliform gramngative bacteria suppressed salmonellae negative bacteria suppressed salmonellae growth 3,000-fold. Coliforms when inoculated prior to salmonellae accounted for 75% of salmonella die-off. Mesophilic curing to allow colonization of curing piles in their entirety by gram-negative bacteria, especially coliforms, should be an effective way to prevent repopulation by salmonellae. (Author's ab-stract)

W88-08799

ALGAE OF A RESERVOIR OF NITROGEN WASTEWATERS,

Warsaw Univ. (Poland). Dept. of Environmental Microbiology. M. Rzeczycka, E. Bonkowska, and M. Przytocka-

Juslak. Acta Hydrobiologica AHBPAX, Vol. 29, No. 1, p 15-24, 1987. 3 tab, 32 ref.

Descriptors: *Nitrogen, *Wastewater, *Species composition, *Wastewater treatment, *Algae, *Chemical wastes, *Wastewater lagoons, *Population dynamics, Culturing techniques, Aquatic habi-

In the final reservoir of wastewaters from the production of nitrogen fertilizers, at a concentration of inorganic N of about 1.2 g/cu dm, Chloreltion of inorganic N of about 1.2 g/cu dm, Chlorel-la sp, Stichococcus sp., and occasionally Chlamy-domonas subcaudata were found to be present. In the surround ditch, at a concentration of inorgaric N about four times lower, a larger number of algal species was observed: Ulothrix sp, Oscillatoria agardhii, Navicula atomus, and Euglena sp. occur-ring in masses. Of the 13 algal species isolated, under laboratory conditions eight grew both on a synthetic medium and on nitrogen wastes. (Au-thor's abstract) W88-08836

REMOVAL OF FLOODWATER NITROGEN IN A CYPRESS SWAMP RECEIVING PRIMARY WASTEWATER EFFLUENT, Central Florida Research and Education Center,

Central Fighta Feesalth.
W. F. DeBusk, and K. R. Reddy.
Hydrobiologia HYDRB8, Vol. 153, No. 1, p 79-86,
October 1987. 4 fig, 2 tab, 22 ref.

Descriptors: *Nitrogen, *Nitrogen removal, *Sediments, *Wetlands, *Wastewater treatment, *Wastewater disposal, *Cypress swamps, *Wastewater, *Fate of pollutants, Nutrient removal, Nitrification, Adsorption, Effluents.

Intact sediment-water columns from a flowing cypress swamp receiving primary wastewater effluent were used to evaluate inorganic N removal and to determine the fate of 15NH4(+)-nitrogen added to the floodwater. Treatments represented wetland sites which had received 0 (initial application), 2, and 50 searce of evinence wastewater conditions. to determine the rate of 15NH4(+)-introgen added to the floodwater. Treatments represented wetland sites which had received 0 (initial application), 2, and 50 years of primary wastewater application. The rate of inorganic-N decrease in the floodwater was greatest for the initial application columns, primarily due to sediment adsorption of NH4(+), followed by 2-year and 50-yr-columns. Maximum removal rates were 318, 296, and 148 mg N/sq m/day, respectively. At the end of the 21-day study period, only 0.5 to 2.3% of applied 15N was recovered in the floodwater and 11.4 to 17.3% was recovered in the sediment, with the remaining 82.2 to 86.3% being lost from the sediment-water system. Results of the study indicated that N removal efficiency did not decrease with prolonged wastewater application, despite reduced sediment adsorption capacity, because of the significance of gaseous N losses (nitrification-denitrification, NH3 volatilization) as an N sink in the sediment-water system. (Author's abstract)

EFFECTS OF THE EFFLUENT OF CHLORIN-ATED MUNICIPAL SEWAGE ON THE GROWTH OF PORPHYRA YEZOENSIS, (IN JAPANESE),

Tokyo Univ. of Fisheries (Japan). For primary bibliographic entry see Field 5E. W88-08881

BIOCHEMICAL OXIDATION OF DISSOLVED ORGANIC MATTER BY SLUDGE ORGANISMS,

Kagawa Univ., Takamatsu (Japan). Dept. of Agricultural Chemistry.

V. Tanaka. Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No.

Group 5D—Waste Treatment Processes

5, p 801-807, May 1987. 3 fig, 2 tab, 9 ref.

Descriptors: *Biological oxygen demand, *Mathematical models, *Aerobic digestion, *Wastewater treatment, *Sludge digestion, *Microbial degradation, Biochemical oxidation, Organic matter.

An experimentally verified theory for the mathematical and biochemical progression of aerobic degradation of dissolved organic matter is presented. The stoichiometric model of biochemical oxied. The stoichiometric model of biochemical oxi-dation of organic matter was verified by three reactions: (1) the combination of the synthesis of microbial cells directly and oxidative conversion microbial cells directly and oxidative conversion into another carbohydrate; (2) the synthesis of microbial cells from the carbohydrate; and (3) the oxidation of microbial cells through endogenous respiration. On the basis of the 3 chemical reactions, the progress of biological oxygen demand (BOD) is mathematically represented as the sum of 5 first-order kinetics. Kinetics parameters were determined by the modification of Lee's graphical states of the progress of the sum of the control of the con method. Excluding the effects of nitrification, the curve obtained from the sum of 3 first-order kinetics agrees well with the observed data. The agree-ment between the theoretical oxygen demand calculated from the chemical equation and experimen-tal ultimate oxygen demand obtained from kinetic analysis of data is excellent for reactions in the microbial growth phase (the reaction of 1 and 2 noted above). The experimental data on bio-oxidation solids production corresponds very nearly to the theoretical value obtained from the chemical equation. (Author's abstract) W88-08882

PERFORMANCE EVALUATION OF AN ACTI-VATED SLUDGE PROCESS USING A PER-SONAL COMPUTER SPREAD SHEET, Johannesburg City Health Dept. Labs. (South

Africa). H. A. Nicholls

Water SA WASAD, Vol. 14, No. 2, p 65-80, April 1988. 2 fig, 16 tab, 10 ref, 3 append.

Descriptors: *Performance evaluation, *Wastewater treatment, *Activated sludge process, *Computer models, Personal computers, Nu-trient removal, Wastewater treatment, Evaluation,

The University of Cape Town's steady state model of the activated sludge process was entered into a spread sheet on a deak-top microcomputer, together with the actual analytical and operational data from a nutrient removal activated sludge plant. With the aid of this spread sheet, it was possible to conduct an in-depth evaluation of the process from both a theoretical and practical point of view, all within a few minutes. Such evaluations are especially useful when endeavoring to optimize the processes, or when investigating operational problems within the process itself. (Author's abstract) W88-08905 The University of Cape Town's steady state model

ENHANCED POLYPHOSPHATE ORGANISM CULTURES IN ACTIVATED SLUDGE SYS-TEMS: PART 1. ENHANCED CULTURE DE-VELOPMENT,

Cape Town Univ. (South Africa). Dept. of Civil Engineering.
M. C. Wentzel, R. E. Loewenthal, G. A. Ekama,

M. C. Wentzel, R. E. Loewentnai, G. A. Ekama, and G. V. R. Marais.
Water SA, Vol. 14, No. 2, p 81-92, April 1988. 10 fig, 6 tab, 23 ref, append.

Descriptors: *Activated sludge process, *Chemical analysis, *Phosphate removal, *Microorganisms, *Nutrients, Polyphosphate organisms, Aerobic culture development, Municipal wastewater, Aerobic

In UCT (University of Capetown) and Bardenpho systems, by starting with 100% municipal wastewater as influent and incrementally decreasing the wastewater fraction and increasing the ing the wastewater fraction and increasing ine acetate fraction, an enhanced culture of polyphos-phate (polyP) organisms was developed. Aerobic cultures, using the API (Analytical Profile Index) procedure, indicated that greater than 90% of the microorganisms as Acinetobacter spp. As the ace-

tate fraction increased, macro- and micro-nutrients and yeast extract addition was necessary to maintain polyP organism growth. Of the macro-nutrients, magnesium, potassium and calcium had to be available in adequate concentrations for P uptake-magnesium and potassium form the principal counter-ions for stabilizing the polyP chain and, to a lesser extent, calcium: calcium was probably involved in other functions. Acid addition was necessary in the aerobic zone to maintain the pH near neutrality. At sludge ages of 10 and 20 days with 100% acetate feed (500 mg COD/I (chemical oxygen demand/I)) removals of about 60 and 50 mg P/I, respectively, were attained, P/VSS (mg VSS/mg TSS) of about 0.38 and VSS/TSS (mg VSS/mg TSS) of about 0.46 in the aerobic zone. This enhanced culture was used to obtain information on the stoichiometry and kinetics of the tion on the stoichiometry and kinetics of the growth of polyP organisms in nutrient removal systems. (Author's abstract) W88-08906

CAUSTIC RECOVERY FROM BOTTLING PLANT EFFLUENT, Natal Univ., Durban (South Africa). Dept. of Chemical Engineering. A. E. Simpson, F. G. Neytzell-de Wilde, and C. A. Buckley.

Buckley. Water SA WASAD, Vol. 14, No. 2, p 99-104, April 1988. 4 fig, 2 tab, 7 ref.

Descriptors: "Industrial wastewater, "Wash water, "Water reuse, "Effluents, "Water treatment, Filtra-tion, Carbonation, Reverse osmosis, Electrolysis, Bottle-washing plants, Chemical treatment, Caustic

The treatment process employed by most bottle-washing plants for the recovery and recycling of water from sodium hydroxide bottle washer efflu-ent involves filtration, activated carbon adsorption and ion exchange. The major disadvantage of the ion-exchange system is that the total dissolved solids load in the final discharge is actually in-creased above that of the effluent due to the regen-eration chemicals. An alternate treatment process for the recovery and recycling of water from retation chemicals. An alternate treatment process for the recovery and recycling of water from bottle washer effluent has been proposed and involves filtration, carbonation and reverse osmosis of the reverse osmosis brine concentrate in an electrochemical membrane cell has been proposed. This will allow for the recovery and reuse of the sodium hydroxide and will minimize the total dissolved solids which are discharged to the wash drain. Investigations, reported elsewhere, on the use of electrochemical techniques for caustic recovery from textile effluents have been successful. Similar techniques used for the treatment of bottle washer effluent will be successful. The technical operating parameters and the economics of the process are not discussed. (Author's abstract) W88-08908

REVIEW OF THE ROLE OF NOCARDIA-LIKE FILAMENTS IN ACTIVATED SLUDGE FOAM-

Maryland Univ., College Park. Dept. of Civil En-

Gineering.
O. J. Hao, P. F. Strom, and Y. C. Wu.
Water SA WASAD, Vol. 14, No. 2, p 105-110,
April 1988, 2 fig, 61 ref.

Descriptors: *Activated sludge process, *Sewage Bacteria, *Foaming, Actinomycetes, Air-water interface, Mixed liquor solids, Aeration.

The common problem of biological foaming asso-The common problem of biological foaming asso-ciated with high concentrations of filamentous No-cardia-like actinomycetes in activated sludge plants is reviewed. These bacteria appear to be hydro-phobic in nature, concentrating on the air/water interface. They are able to metabolize lipids and hydrocarbons which are not readily available to many other bacteria. Foaming control techniques include reduction of MLSS (mixed liquor suspend-ed solids) and aeration rate, selection against Noed solids) and aeration rate, selection against No-cardia-like filaments by increased F/M (food to microorganisms ratio) and decreased solids reten-tion time, and elimination of concentrated fila-ments in recycle streams from solids-handling fa-cilities. (Author's abstract) W88-08909

MODELLING AND OPTIMIZATION OF FIXED-NOZZLE TARGETED CHLORINA-

Metcalf and Eddy, Inc., Wakefield, MA. D. N. Brocard, Y. Mussalli, and W. Chow. Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 5, p 544-556, May 1988. 8 fig, 14 ref, 2

Descriptors: *Cooling waters, *Model studies, *Mathematical models, *Hydraulic engineering, *Power plants, *Chlorination, *Water treatment, *Nozzles, Optimization, Fixed-nozzle targeted chlorination.

Environmental limits on chlorine levels in power plant cooling water discharges have prompted the development of various techniques to reduce the use of chlorine without impacting plant performance. One such techniques is targeted chlorination. The concept is to chlorinate a fraction of the condenser tubes at a time with a relatively high chlorine concentration that, after passage through the condenser tubes, will mix with the unchlorinated flow to meet the discharge criterion. This paper the condenser tubes, will mix with the unchlorinated flow to meet the discharge criterion. This paper describes a mathematical model of the impingement of chlorinated jets on a condenser tubesheet to predict the distribution of chlorine concentrato predict the distribution of chlorine concentra-tions in the tubes as a result of injection through fixed nozzles. This model compares well with physical model measurements. In the second half of the paper, the optimization of a fixed-nozzle targeted chlorination system for practical applica-tions is discussed. A sample application with a typical inlet condenser waterbox (tubesheet area 9.3 sq m; circulating water flowrate 5.5 cu m/sec) is described. (Author's abstract)

5E. Ultimate Disposal Of Wastes

NITROGEN RELEASE FROM WASTEWATER SLUDGE: A SITE SPECIFIC APPROACH,

Arkansas Univ. at Monticello. Dept. of Agronomy. J. T. Gilmour, and M. D. Clark. Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 4, p 494-498, April 1988. 7 fig, 2 tab, 19 ref.

Descriptors: *Sludge utilization, *Wastewater irrigation, *Nitrogen compounds, *Plant available nitrogen, Computer simulation, Climates.

An analytical-computer simulation approach to determine plant available nitrogen (PAN) in wastewater sludge was described and verified, and then compared to the constant factor approach where an invariant percentage (usually 20%) of the organic-N in sludge was assumed to contribute to PAN. The simulation approach estimated PAN values that varied with climate, among sludges, and in sludges. The latter estimates were substantially larger than the constant factor approach and exhibited considerable variability that suggested that the constant factor approach would provide poor estimates of PAN under most conditions. Estimates of PAN using the analytical-computer simulation approach were related to sludge analytical data for two sludges. (Author's abstract) W88-08005

SOIL CHANGES CAUSED BY MUNICIPAL WASTEWATER APPLICATIONS IN EASTERN SOUTH DAKOTA,

South Dakota State Univ., Brookings. Dept. of Plant Science. E. M. White, and J. N. Dornbush.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 269-273, April 1988. 1 fig, 4 tab, 16 ref.

Descriptors: *Soil chemistry, *Land disposal, *Soil physical properties, *Soil properties, *South Dakota, *Path of pollutants, *Water pollution effects, *Waste disposal, *Wastewater, Infiltration, Soil mechanics, Hydrology, Soil properties, Nitrogen, Phosphorus, Phosphates, Sorption.

Ultimate Disposal Of Wastes-Group 5E

Wastewater from a municipal treatment plant was applied in rapid infiltration basins for four years to determine a poorly drained soil's effectiveness in removing influent N and P and the soil changes that might limit their removal. About half the total PO4-P lost from the influent was sorbed in the upper 91 cm of the soil and the other half was sorbed by the soil below the perforated pipe, which was used to drain the basins and collect the effluent for analysis. Drying of the basin soils converted more sorbed PO4-P to Ca phosphates but the total sorbed was about the same. The influent N decreased, probably by volatilization, because the two basins with surface soil lost soil N rather than gained soil N. The soil total Ca, Mg, and K contents did not change significantly but Na increased slightly. Changes in the physical characteristics of the soils were slight and would have little effect on the longevity of a rapid infiltration basin. (Author's abstract)

IMPROVEMENT IN AEROBIC SLUDGE DI-GESTION THROUGH PH CONTROL: INITIAL ASSESSMENT OF PILOT-SCALE STUDIES, British Columbia Univ., Vancouver. Dept. of Civil

Engineering.
B. C. Anderson, and D. S. Mavinic. Canadian Journal of Civil Engineering CJCEB8, Vol. 14, No. 4, p 477-484, August, 1987. 3 fig, 3

Descriptors: *Wastewater treatment, *Sludge digestion, *Aerobic digestion, *Hydrogen ion concentration, *Pilot plants, Performance evaluation, Lime, Biodegradation, Digestion, Wastewater facilities, Retention time, Nitrification, Bicarbonates.

Waste-activated sludges from an extended-aeration, pilot-scale wastewater treatment facility and a high-rate, full-scale system were digested aerobically in 150-1 pilot scale digesters operated in asmicontinuous mode. Hydrated lime and sodium bicarbonate were used in separate experiments to control the mixed-liquor pH decrease normally encountered in these digesters. Digester performance was assessed on the basis of reduction in total volatile suspended solids. The extended-aeration sludge showed the greatest improvement in process performance under all pH-controlled conditions, with improvements in digestion efficiency of up to 80%. Lime was more effective than sodium bicarbonate with this sludge, without a significant up to 80%. Lime was more effective than sodium bicarbonate with this sludge, without a significant increase in sludge solids production (owing to the low chemical doses required). Digestion efficiency of the high-rate sludge was little improved with either chemical, although absolute efficiencies of some individual digesters were nearly double those of the comparative extended-aeration digesters. This difference appears to be a function of the process from which the digesting sludge originated, and seems to be influenced by the amount of easily oxidizable, endogenous substrate contained in the biomass. It is concluded that the extended-aeration type sludge was most amenable to enaeration type sludge was most amenable to en-hanced digestion through pH control, and that cost and process considerations make lime the chemical of choice. (Doria-PTT)

TREES AND SHRUBS FOR CONTROL OF TANNERY WASTEWATER IN INDIA, Conservator of Forests, Research and Development, Lucknow (India).

Environmental Conservation EVCNA4, Vol. 13, No. 2, p 164-165, Summer 1986. 1 fig. 3 tab.

Descriptors: *Wastewater irrigation, *Wastewater disposal, *Tannery wastes, *Irrigation, Crop yield, Trees, Shrubs, India, Plant growth.

Tannery wastewater contains effluents that cause serious pollution problems. In an irrigation study, twelve species of trees and shrubs were tested for their tolerance to such water. Chir showed the greatest mortality, apparently owing to the unsui-tability of the climatic conditions for that species. Babul, Arjun, Lisora, Awaram and Arusa all showed better growth in diameter and height when irrigated with polluted water than with clean

water. The barks of Babul, Arjun and Awaram are important vegetable tannin materials for the leather industry. As these species grow well with tannery wastewater, the effluents, after partial treatment, could accordingly be used for irrigation, to the mutual benefit for the leather industry and the environment. (Sand-PTT) W88-08213

WATER-RELATED LIMITATIONS TO LOCAL DEVELOPMENT, Swedish Natural Science Research Council, Stockholm. For primary bibliographic entry see Field 4C. W88-08226

STUDIES OF THE INFILTRATION AND MI-GRATION OF BRINE IN POTASH TAILINGS, Saskatchewan Univ., Saskatoon. Dept. of Civil Eneering. For primary bibliographic entry see Field 5B. W88-08305

DESIGN OF LYSIMETER LEAK DETECTOR NETWORKS FOR SURFACE IMPOUNDMENTS AND LANDFILLS,

In-Situ, Inc., Laramie, WY. Computer Technology For primary bibliographic entry see Field 7A. W88-08315

ANALYTICAL SOLUTIONS FOR TWO-DI-MENSIONAL CHEMICAL TRANSPORT IN AQUIFERS, Thessaloniki Univ., Salonika (Greece). School of Technology. For primary bibliographic entry see Field 5B. W88-08324

LABORATORY EVALUATION OF SOLID RES-IDUES FROM ATMOSPHERIC FLUIDIZED BED COMBUSTION SYSTEMS,

Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre. T. W. Constable, R. Kissel, S. E. Sawell, and W. unningham.

Canadian Journal of Civil Engineering CJCEB8, Vol. 15, No. 1, p 49-57, 1988. 9 fig, 4 tab, 10 ref.

Descriptors: *Solid wastes, *Industrial wastes, *Fluidized bed combustion process, Coal, Leaching, Calcium, Sulfur, Sulfates.

Tests and analyses were conducted to characterize tests and analyses were conducted to characterize the physical, chemical, exothermic, and leaching properties of solid residues from bubbling bed at-mospheric fludized bed combustion units. The res-idues were produced during the combustion of eastern Canadian high-sulfur bituminous coals (4-8% sulfur) in a bed of eastern Canadian limestone. 8% sulfur) in a bed of eastern Canadian limestone. The residues were highly buffered and composed primarily of calcium and sulfur salts. They were exothermic and swelled considerably when contacted with water. Leachates generated during 20-cycle serial batch leaching tests were highly alkaline with high total dissolved solids concentrations, primarily calcium and sulfate ions. Calcium leaching test results and field observations suggest reactions may continue to occur over several months until the residues eventually solidify. The residues have properties that are unique, in comparison have properties that are unique, in comparison with conventional pulverized coal combustion wastes. (Author's abstract)
W88-08360

EFFECT OF SEWAGE-SLUDGE ON THE HEAVY METAL CONTENT OF SOILS AND

Nova Scotia Agricultural Coll., Truro. K. S. MacLean, A. R. Robinson, and H. M.

MacConnell.

Communications in Soil Science and Plant Analysis CSOSA2, Vol. 18, No. 11, p 1303-1316, 1987. 6

Descriptors: *Sludge utilization, *Wastewater disposal, *Fertilization, *Land application, *Heavy

metals, *Soil chemistry, *Plant physiology, *Path of pollutants, Legumes, Grasses, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc.

Domestic sewage sludge applied to farm fields at a rate of 44.9 kg/ha in a mixture with lime and sawdust increased the soil levels of Cd, Cr, Cu, Pb, Hg, Ni and Zn. The average levels in sludge treated soil were: 0.11, 0.56, 3.59, 2,72, 0.068, 1.49 and 2.57 ppm, respectively. The increases were small and the overall loading factors were well below recommended maximums. The uptake of these heavy metals by grass and legume plants was variable with Cd, Cu and Zn levels being higher in those plants growing in the sludge treated soils, but only Cu was significantly higher. The heavy metal contents found were all within the levels normally found in grass and legume plants. The higher mean found in grass and legume plants. The higher mean concentration in plants growing on the studge treated soils were Cd 0.495; Cr 1.22; Cu 12.3; Pb 1.54; Hg 0.022; Ni 4.08 and Zn 28.4 ppm. (Author's

SOLID WASTE HANDBOOK: A PRACTICAL GUIDE.

John Wiley and Sons, New York. 1986. 811 p. Edited by William D. Robinson.

Descriptors: *Solid wastes, *Handbooks, *Legisla-tion, *Waste management, *Land disposal, *Waste disposal, *Regulations, Legal aspects, Hazardous wastes, Case studies, Industrial wastes, Resource Conservation and Recovery Act, Costs, Economic aspects, Municipal waste

The management of solid wastes has assumed greater dimension and complexity. Government regulation, new technologies for disposal and recovery, complex legal issues and increased public concern have made the waste control engineer's and manager's jobs more difficult and more visible. Readers of the handbook will find current informaition, technical data, and practical guidance on leg-islation, regulation, planning, finance, technologies, operations, economics, administration, public per-ception, and trends for the future. The initial secception, and trends for the nuture. The initial sec-tion, devoted to public issues, examines legislation and regulation (including November 1984 amend-ments to the Resource Conservation and Recovery Act), public perceptions, feasibility studies, pro-currement and construction management, waste dis-posal and resource recovery plant costs, financing, current and construction management, posal and resource recovery plant costs, financing, and legal issues. Section Two reviews implementation issues, including collection of residential solid waste, transfer of municipal solid waste, source separation and citizen recycling, land disposal, all aspects of resource recovery, bulky waste disposal, biological processes, and three case studies of refuse fuels in the portland cement industry. A study of hazardous solid wastes and their regulatory aspects constitutes the third and final section. tory aspects constitutes the third and final section. (See W88-08388 thru W88-08390) (Lantz-PTT) W88-08387

LAND DISPOSAL,

Wisconsin Univ.-Madison. VISCOSSIN OF PARAMENT OF THE ACT OF THE ACT

Descriptors: *Landfills, *Waste disposal, Solid wastes, Leaching, Leachates, Regulations, Standards, Site selection, Waste management, Public Environmental protection, Legislation,

Detailed discussion, graphic, tabular, and formulae presentation of landfill methods, in situ and migratory biological and chemical processes, environmental protection, government guidelines, siting procedures and public involvement, leachate fornation and control, nethane gas formation and control, equipment selection and utilization, site closure and long-term care are features of this chapter. Appendices for regulated contaminant levels, facilities classification, site-rating methods, and decision matrices for site selection factors are included. High- and medium-density 'balefill' logis-

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tics, methods, equipment, and benefits are examined along with the 'shredfill' concept. (Author's abstract) W88-08388

FEDERAL REGULATORY ISSUES, Jaeckle, Fleischmann and Mugel, Washington,

For primary bibliographic entry see Field 5G. W88-08390

UTILIZATION OF FLUIDIZED BED COMBUSTION WASTE,

TION WASTE, Kentucky Univ., Lexington.
R. I. Barnhisel, and W. O. Thom.
Available from the National Technical Information Service, Springfield, VA 22161, as DE87-900884.
Price codes: A06 in paper copy, A01 in microfiche. Tennessee Valley Authority Report No. TVA/PUB-87/18, (1986), 93 p. 4 fig, 30 tab, 18 ref. TVA Contract TV-60443A.

Descriptors: "Waste disposal, "Land disposal, "Fluidized bed process, "Wastes, "Hydrogen ion concentration, Alfalfa, Soybeans, Soil chemistry, Heavy metals, Toxicity, Sulfates, Boron, Zinc, Nutrients, Organic wastes

Spent bed materials (SBM) were evaluated as a Spent bed materials (SBM) were evaluated as a potential liming agent in two laboratory and five greenhouse experiments. The effectiveness of SBM to change the pH of an acidic soil was compared with CaCO3. The germination and growth of alfalfa and soybeans were monitored in the greenhouse and the study also included chemical composition of the plants and changes in chemical properties of the soil. Excessive rates of SBM should be avoided with further information is devalored as generating. until further information is developed as germina-tion of small seeded crops was reduced and there tion of small seeded crops was reduced and there may be a risk of formation of a 'plastic'-like material. When properly used, SBM may serve as a source for sulfate-sulfur, boron, and zinc. Concentations of environmentally-sensitive heavy metals (Pb, Cd, Cu, Ni, and Cr) in harvested plant tissues were not related to treatment variables and in most the concentrations of these elements were below detection levels with no toxic effects being noted. (Author's abstract) V88-08391

CRITICAL REVIEW OF CEMENT BASE STA-BILIZATION/SOLIDIFICATION TECH-NIQUES FOR THE DISPOSAL OF HAZARD-

Clark (A.) and Associates, Twickenham (England).

A. Clark.

Available from the National Technical Information Available from the National Technical Information Service, Springfield, VA 22161, as ADA-184 427. Price codes: AO4 in paper copy, AO1 in microfiche. Final Report, 1986. 46 p, 6 fig, 2 tab, 114 ref.

Descriptors: *Cements, *Stabilization, *Solidifica-tion, *Waste disposal, *Waste disposal, *Hazardous wastes, Portland cement, Ash, Sodium silicate, In-organic compounds, Heavy metals, Silicates, Liter-

The materials used in stabilization/solidification processes (ordinary Portland cement (OPC) pulverized fuel ash (PFA) and sodium silicate) are reviewed in terms of their basic composition and chemistry. The addition of inorganic wastes to OPC and PFA is demonstrated, affecting early hydration, and leads to the development of the protective coating theory and sorption of heavy metals by PFA, as the principal factors involved in stabilization. The aqueous chemistry of OPC, PFA, PFA/OPC and PFA/OPC/Silicates is also reviewed and illustrates the chemical reactions PFA, PFA/OPC and PFA/OPC/Silicates is also reviewed and illustrates the chemical reactions taking place during the first hour of the stabiliza-tion process. Methods to improve the efficiency of this Sealosafe process are highlighted, particularly with respect to supernatant formation. New devel-opments, such as the use of clays, are highlighted. (Author's abstract)

BIOENERGETIC EFFECTS OF BLACK ROCK HARBOR DREDGED MATERIAL ON THE PO-

LYCHAETE NEPHTYS INCISA: A FIELD VER-IFICATION,

PTI Environmental Services, Seattle, WA. For primary bibliographic entry see Field 5C. W88-08420

NATIONAL DIOXIN STUDY. TIER 4 - COM-BUSTION SOURCES: FINAL TEST REPORT -SITE 1, SEWAGE SLUDGE INCINERATOR SSI

- A,
Radian Corp., Research Triangle Park, NC.
L. E. Keller, C. R. Blackley, and R. F. Jongleux.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB87-233250.
Price codes: A06 in paper copy, A01 in microfiche.
EPA Report No. EPA-450/4-84-014j, April 1987.
162 p. 24 fig. 26 tab, 6 append. EPA Contract No.
68-03-3148.

Descriptors: *Air pollution, *Water pollution sources, *Dioxin, *Combustion, *Furans, *Incineration, Sludge, Tetrachlorodibenzo-p-dioxin, Tetrachlorodibenzofuran, Ash, Chlorobenzenes, Chlorophenols, Organic compounds.

A dioxin/furan emissions test was conducted on a multiple hearth sewage sludge incinerator equipped with a wet scrubber system for particulate emissions control. The test was the first in a series of thirteen dioxin/furan emissions tests conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are sources of dioxin The primary objective of Her 4 is to determine it various combustion sources are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantity these emissions. Detectable quantities of all targeted dioxin and furan species were found in the scrubber outlet emissions. Average as-measured scrub-ber outlet emission concentrations of 2378-TCDD, total PCDD, and total PCDF were 0.006 nano-grams/dscm, 2.85 nanograms/dscm, and 6.36 nanograms/dscm, 2.85 nanograms/dscm, and 6.36 nano-grams/dscm, respectively. The tetrachlorinated CCD and CDF homologues were the predominant species present. Incinerator bottom ash samples did not contain detectable quantities of any of the targeted dioxin and furan species. The sludge feed contained 0.01 micrograms/gm of chlorobenzenes, but polychlorinated biphenyls and chlorophenyls were not detected. The average total chlorine con-centration of the sludge feed was 60 micrograms/ were not detected. The average total chlorine concentration of the sludge feed was 606 micrograms/gm. The dry sludge feed rate to the incinerator averaged 877 lb/hr during the test period, and the mean temperatures for individual hearths ranged from 127 F to 1438 F. Average as-measured incinerator outlet gas concentrations measured by the continuous emissions monitoring were: O2, 11.9 vol%; CO, 2470 ppmv; CO2, 14.0 vol%; THC, 152 ppmv, 1590 ppmb; and NOx, 465 ppmv. (Lantz-PTT) W88-08427

SOLVING HAZARDOUS WASTE PROBLEMS: LEARNING FROM DIOXINS.

LEARNING FROM DIOXINS.

International Technology Corp., Marinez, CA.

American Chemical Society, Washington, DC.

ACS Symposium Series No. 338. Based on a symposium sponsored by the Division of Environmental Chemistry at the 191st Meeting of the American Chemical Society, New York, NY, April 13-18, 1986. 1987. 397 p. Edited by Jurgen H. Exner.

Descriptors: *Waste disposal, *Hazardous materials, *Dioxins, *Chemical wastes, *Industrial wastes, *Cleanup, *Decontamination, *Contamination, Pollutants, Toxicity, Risks, Monitoring, Environmental effects, Wastewater treatment.

Many dioxin issues are inherent to hazardous waste Many dioxin issues are inherent to nazardous waste cleanup; therefore, strategies for dioxin cleanup serve as models for future remediation at other types of hazardous waste sites. The conflicting attitudes of the public, industry, scientists, and regulators tend to delay remedies to dioxin contamination problems. This 31-chapter book attempts to provide a consensus necessary to solve these problems. The volume is divided into sections covering distribution and toxicology, risk as-sessment and risk management. Specific topics in-clude risk-qualified mapping, ambient air monitor-ing, the national dioxin study, permitting remedial

action research, and mobility of 2,3,7,8-tetrachlorodibenzo-p-dioxin. Other topics include the environ-mental chemistry of dioxin, assessing human expo-sure to dioxin-contaminated soil and decontamina tion instrumentation and techniques. (See W88-08432 thru W88-08441) (VerNooy-PTT) W88-08431

PERSPECTIVE ON HAZARDOUS WASTE PROBLEMS RELATED TO DIOXINS,

International Technology Corp., Marinez, CA.

IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Washington, DC. 1987. p 1-17, 4 tab, 23 ref.

Descriptors: *Waste disposal, *Risk assessment, *Dioxins, *Chemical wastes, *Cleanup, *Contamination, *Environmental effects, *Hazardous materials, Industrial wastes, Toxicity, Reviews.

Polychlorinated dibenzo-p-dioxins (PCDD) represent a highly visible, well-studied class of pollutants that are acutely toxic to animals. Information about these chemicals and experience with many about these chemicals and experience with many environmental contamination episodes serve as a guide for solving hazardous waste problems caused by other pollutants. Solutions require the recognition of a problem, such as the widespread distribution of a pollutant in the environment, releases of pollutants from chemical processes, or their presence at hazardous waste sites. After concern about the presence of pollutants in the environment arises, the risk posed by chemicals such as dioxins must be assessed. Such risk assessment requires an understanding of the acute and chronic toxicity of the pollutant and knowledge of pathways by which humans and animals can be exposed to the chemical. Subsequent risk management involves which numans and animass can be exposed to the chemical. Subsequent risk management involves social, political, legal, and economic factors that interact with potential technical options. The major issues relating to cleanup of dioxins in the environment are described from experiences at sites in the United States and Europe. (See also W89.08431) (Author: bettern!) W88-08431) (Author's abstract) W88-08432

PERSISTENT TOXIC ORGANIC WASTE: IS DESTRUCTION NECESSARY,

Eco Logic, Inc., Acton (Ontario). For primary bibliographic entry see Field 5B. W88-08436

CASE STUDY AND PROPOSED DECONTAMINATION OF A CLOSED HERBICIDE PLANT IN THE FEDERAL REPUBLIC OF GERMANY, Dekonta G.m.b.H., Mainz (Germany, F.R.).

H. J. Jurgens, and R. Roth. IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Washington, DC. 1987. p 221-228, 1 fig, 2 tab, 3 ref.

Descriptors: *Waste disposal, *Decontamination, *Chlorinated hydrocarbons, *Lindane, *Cleanup, *Case studies, *Cleanup operations, *Industrial plants, *Soil contamination, *Groundwater pollution, *Chemical industry, *Herbicides, West Germany, Chemical wastes, Industrial wastes.

This chapter describes the background to the closing of a 50 million DM chemical plant in Hamburg, Federal Republic of Germany, and proposed decontamination steps. In 1951 the plant began production of the herbicide hexachlorocyclohesproduction of the heroicide headsimocyclonea-ane and the corresponding isolation of lindane. Closing of the plant was largely due to public pressure. Guidelines for cleanup, and monitoring of soil and groundwater contamination is disof soil and groundwater contamination is dis-cussed. Four levels of worker protection have been established, based upon potential exposure during the cleanup. Cleaning water and surface runoff will be collected and treated by filtration through an activated carbon system. The authors expect to meet or exceed the discharge criteria to the Ham-burg waste water treatment plant of 1 nanogram/L of tetrachlorodibenzodioxin. (See also W88-08431) (VerNooy-PTT)

Ultimate Disposal Of Wastes-Group 5E

REMEDIATION OF A DIOXIN-CONTAMI-NATED SURFACE IMPOUNDMENT, Syntex Agribusiness, Inc., Springfield, MO. For primary bibliographic entry see Field 5G. For prima W88-08439

REMOVAL OF 2,3,7,8-TETRACHLORODICH-LORODIBENZO-P-DIOXIN FROM WASTE WATER AND WELL WATER: COAGULATION AND FLOCCULATION WITH ALUMINUM

SALTS, Syntex (USA), Inc., Palo Alto, CA. L. Marple, D. D. Rossi, and L. Throop. IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Wash-ington, DC. 1987. p 286-290, 4 tab, 4 ref.

Descriptors: *Decontamination, *Dioxins, *Coagu-lation, *Waste treatment, *Water quality control, *Wastewater lagoons, *Chemical coagulation, *Aluminum sulfate, *Flocculation, *Alum, *Chem-ical wastewater, *Well water, Adsorption, Trace

At various times, water in a wastewater lagoon contained several parts per trillion 2,3,7,8-tetrachlorodibenzo-p-dioxin (dioxin). A process was developed for the removal of trace amounts based on coagulation and flocculation with aluminum salts. On site treatment utilized a batch process in which suspended solids were coagulated with 1200 mg/L aluminum sulfate. A polymer modified alum flocculation process was developed for the removal of dioxin from well water. The modification of the floc surface by the adsorption of an uncharged, high molecular weight polymer intensifies the adsorption of dioxin on the floc. (See also W88-08431) (Author's abstract)

BIODEGRADATION OF CHLORINATED OR-GANIC COMPOUNDS BY PHANEROCHAETE CHRYSOSPORIUM, A WOOD-ROTTING

FUNGUS, Michigan State Univ., East Lansing. Dept. of Bio-chemistry.

Chemistry.
J. A. Bumpus, and S. D. Aust.
IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Washington, DC. 1987. p 340-349, 2 fig, 4 tab, 39 ref.

Descriptors: "Waste treatment, "Biodegradation, "Microbial degradation, "Phanerochaete chrysosporium, "Chlorinated hydrocarbons, "Fate of pollutants, "Fungi, "Soil fungi, "Mineralization, DDT, Dioxin, Lindane, Polychlorinated biphenyls, Nitrogen, Deficient elements, Biological wastewater treatment.

The white rot fungus, Phanerochaete chrysospor-ium, is able to mineralize a number of environmen-The white rot fungus, Phanerochaete chrysosporium, is able to mineralize a number of environmentally persistent organochlorides such as 1,1-bis(chlorophenyl)2,2,2-trichloroethane (DDT), polychlorinated biphenyls (PCBs), 2,3,7,8-tetrachloroethenz(ophidoxin (2,3,7,8-TCDD), Lindane (1,2,3,4,56-hexachlorocychotaxane), and pentachlorophenol (PCP). Studies suggest that the ability to degrade these compounds is dependent upon the lignin degrading system of this fungus. For example, like (14)C-lignin mineralization, mineralization of (14)C-pentachlorophenol ((14)C-PCP) and DDT is promoted in nutrient nitrogen deficient cultures of P. chrysosporium whereas their mineralization is suppressed in nutrient nitrogen sufficient cultures. Also, the temporal onset and disappearance of both (14)C-PCP and (14)C-DDT mineralization appeared similar to that observed for (14)C-lignin, thus suggesting that the same general degradative system may be responsible. It is suggested that the ability of P. chrysosporium to mineralize such a wide variety of organochlorides may make this fungus a useful microorganism for use in the biological treatment of comministed exits estiments and success. ganochrorides may make this lungus a userul microorganism for use in the biological treatment of contaminated soils, sediments and aqueous wastes when used in appropriate aerated waste treatment systems. (See also W88-08431) (Author's abstract) W88-08441

REGIONAL GROUND-WATER FLOW NEAR RICHTON AND CYPRESS CREEK DOMES,

MISSISSIPPI: ANNUAL STATUS REPORT FOR FISCAL YEAR 1984. Earth Technology Corp., Long Beach, CA. For primary bibliographic entry see Field 2F. W88-08511

HAZARDOUS WASTE REGULATION HAND-BOOK: A PRACTICAL GUIDE TO RCRA AND SUPERFUND, Wald, Harkrader and Ross, Washington, DC. For primary bibliographic entry see Field 5G. W88-08515

PREDICTION OF VERTICAL TRANSPORT OF LOW-LEVEL RADIOACTIVE MIDDLESEX SOIL AT A DEEP-OCEAN DISPOSAL SITE, Environmental Research Lab., Narragansett, RI. For primary bibliographic entry see Field 5B. W88-08542

FIELD VERIFICATION OF HELP MODEL FOR LANDFILLS,
Missouri Univ.-Columbia. Dept. of Civil Engineer-

Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 247-269, April 1988. 8 fig. 4 tab,

Descriptors: *Landfills, *Path of pollutants, *Leachates, *Groundwater pollution, *Contamination, *Pollutants, *Computer models, *Model studies, Design criteria, Surface water, HELP model, Hydrologic evaluation, Water balance, Runoff, Performance evaluation, Hydraulic conductivity.

Long-term simulations of 17 landfill cells from six sites are performed using the Hydrologic Evaluation of Landfill Performance (HELP) computer model. Results are compared with field data from a variety of landfills to verify the model and to identify shortcomings. The sites are located in California, Kentucky, and Wisconsin. Since site data are not available for some of the model input parameters, default values are used in many instances. It is found that model predictions are generally bracketed by field measurements. Good agreement between the predictions and the measurements is obtained by calibrating the hydraulic conductivity of the cover materials while staying within the range of hydraulic conductivity values reported in the literature for these materials. The results indicate that the HELP model can be a very useful tool for designing and evaluating landvery useful tool for designing and evaluating land-fills. Additional data are required to rigorously test many of the model assumptions and mechanisms. (Author's abstract) W88-08568

ABSENCE OF ASBESTOS IN MUNICIPAL SEWAGE SLUDGE ASHES, Environmental Science and Engineering, Inc.,

Gainesville, FL. . J. Patel-Mandlik, C. G. Manos, and D. J. Lisk. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 5, p 703-706, May 1988. 2 tab, 5 ref.

Descriptors: *Asbestos, *Sludge disposal, Waste disposal, Landfills, Incineration.

Sewage sludge ashes from 10 American cities were analyzed for the presence of asbestos fibers. In all cases sludges had been dewatered by vacuum fil-tration, some with chemical addition. Incineration peratures varied from 775 to 1000 C. No asbesremperatures varied from 7/5 to 1000 C. No asbes-tos fibers were detected in any sludge. This was attributed to the high incineration temperatures, which altered the mineral form, and the high or-ganic matter content, which chemically reduced the silicate by reaction with carbon radicals at high temperature (Cassar-PET). temperature. (Cassar-PTT) W88-08681

ACCUMULATION OF PERIPHYTON BIOMASS ON ARTIFICIAL SUBSTRATES DE-PLOYED NEAR A SEWAGE SLUDGE OUT-FALL IN SOUTH AUSTRALIA,

South Australia Engineering and Water Supply Dept., Salisbury. State Water Labs. For primary bibliographic entry see Field 5C.

CHEMICAL AND DECOMPOSITION CHAR-ACTERISTICS OF ANAEROBIC DIGESTER EFFLUENTS APPLIED TO SOIL,

Southeast Kansas Branch Experiment Station, Parsons. For primary bibliographic entry see Field 5D. W88-08762

EFFECTS OF SLUDGE APPLICATION SE-QUENCE ON CARBON AND NITROGEN MIN-ERALIZATION IN SOIL,

Maine Univ. at Orono. Dept. of Plant and Soil

J. T. Wiseman, and L. M. Zibilske.

Journal of Environmental Quality JEVQAA, Vol. 17, No. 2, p 334-339, April-June 1988. 8 fig. 3 tab,

Descriptors: "Wastewater disposal, "Sludge disposal, "Soil amendments, "Mineralization, "Nitrogen, "Land disposal, "Industrial wastes, "Carbon, Decomposition, Chromium, Tannery wastes, Heavy metals, Metals, Respiration.

A laboratory experiment was conducted to determine the effects of an initial sludge amendment on C and, primarily, N mineralization of a second sludge amendment. In this study, a municipal sludge containing Cr-tanning effluent, and a domestic sludge with little metal contamination were added to a sandy loans soil at vates of 665 a mestic sludge with little metal contamination were added to a sandy loam soil at rates of 6.65 g domestic sludge/kg soil and 9.75 municipal sludge/kg soil. Sludges were reapplied 40 d later at the same rates in all sequence combinations. Respiration and nitrification were increased in sludge-amended soil. At least 70% of the total C mineralized from both sludges was evolved within the first ized from both sludges was evolved within the first 11 d. Initial sludge application had little effect on C evolution from subsequent applications. Nitrogen mineralized from sludge-amended soils during the initial 40 d of incubation was linearly related to time. A second application of sludge did not change the linear nature of N mineralization in all change the linear nature of N mineralization in all but one treatment. Ammonium N rapidly decreased and was negligible 2 weeks after sludge addition. Nitrite nitrogen levels were negligible throughout the experiment. By the end of the incubation period, the quantity of nitrate produced in all sequences of sludge addition was similar. Results indicate little effect of initial sludge addition on C and N mineralization of a second sludge amendment, even if the initial sludge applied contained a high concentration of Cr. (Author's abstract) stract) W88-08764

RECYCLING OF THE AQUATIC WEED, WATER HYACINTH, AND ANIMAL WASTES IN THE REARING OF INDIAN MAJOR CARPS,

Central Inst. of Freshwater Aquaculture, Bhubaneswar (India) For primary bibliographic entry see Field 81.

USE OF BIOASSAY AND ASSOCIATED TESTS IN DREDGED MATERIAL AND DISPOSAL MANAGEMENT.

Corps of Engineers, Vicksburg, MS. For primary bibliographic entry see Field 5A. W88-08863

CONTAMINATED SEDIMENTS IN THE ELBE ESTUARY: ECOLOGICAL AND ECONOMIC PROBLEMS FOR THE PORT OF HAMBURG, Behoerde fuer Wirtschaft, Verkehr und Landwirtschaft, Hamburg (Germany, F.R.). I. Tent.

Hydrobiologia HYDRB8, Vol. 149, p 189-199, June 1987. 7 fig, 3 tab, 52 ref.

Group 5E-Ultimate Disposal Of Wastes

Descriptors: *Estuaries, *Contamination, *Ecological effects, *Economic impact, *Dredging, *Hamburg, *Sediments, *Waste disposal, *Coastal waters, *Land disposal, Hamburg, Elbe estuary, Wastewater treatment, Agriculture.

The lower Elbe is polluted by poorly treated domestic sewage and industrial effluent. This has led to a major change on the oxygen content of the water and to the presence of contaminated sediment. The Port of Hamburg is situated in the limnic region of the Elbe estuary in West Germany. The areas for cargo handling and storage, industrial and merchant firms, harbor basins and the river Elbe cover 87 sq km (12% of the Hamburg state territory). In the lower Elbe and in many water-ways within the harbor, water depths (about 13 m) are maintained by dredging. The resulting 2.5-million cu m of dredged material are disposed on land by hydraulic transport. With increasing knowledge about sediment contamination, problems have arisen regarding further disposal. Intensive investigations have been conducted concerning alternative solutions, waste water treatment, safety for groundwater, gasification, metal cerning atternative solutions, waste water treat-ment, safety for groundwater, gasification, metal extraction and possibilities for agricultural use. Techniques have been developed for the con-trolled disposal of dredged material in hill-shaped deposals. (Author's abstract) W88-08866

REMOVAL OF FLOODWATER NITROGEN IN A CYPRESS SWAMP RECEIVING PRIMARY WASTEWATER EFFLUENT, Central Florida Research and Education Center, Sanford, FL.

For primary bibliographic entry see Field 5D. W88-08871

BENTHIC COMMUNITIES AND THEIR PHYSICAL ENVIRONMENT IN RELATION TO URBAN POLLUTION FROM THE CITY OF TROMSO, NORWAY: I. THE PHYSICAL ENVIRONMENT: HYDROGRAPHY, PLANT NUTRIENTS, ORGANIC ENRICHMENT, HEAVY METALS, AND REDOX CONDITIONS, Tromsoe Univ. (Norway). Dept. of Marine Biology.

ogy. For primary bibliographic entry see Field 5C. W88-08879

BENTHIC COMMUNITIES AND THEIR PHYSICAL ENVIRONMENT IN RELATION TO URBAN POLLUTION FROM THE CITY OF TROMSO, NORWAY: II. SOFT-BOTTOM COMMUNITIES,

Tromsoe Univ. (Norway). Dept. of Marine Biol-

ogy. For primary bibliographic entry see Field 5C. W88-08880

EFFECTS OF THE EFFLUENT OF CHLORIN ATED MUNICIPAL SEWAGE ON THE GROWTH OF PORPHYRA YEZOENSIS, (IN JAPANESE).

Tokyo Univ. of Fisheries (Japan). T. Maruyama, A. Miura, and T. Yoshida. Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No. 3, p 465-472, March 1987. 8 fig, 16 ref.

Descriptors: *Rhodophyta, *Wastewater treatment, *Sludge, *Wastewater pollution, *Chlorination, *Phytotoxicity, *Effluents, Activated sludge, Algae.

The effects of chlorinated effluent of activated sludge treatment on the growth of Porphyra yezoensis were investigated with different chlorinated effluent-dosed culture media and different chlorine-dosed, diluted Provasoli's Enriched Seawater rme-to-sed, diluted Provision's Enficience Seawater (PES) culture media as a control. To clarify the effect of the chlorinated effluent on Porphyra thalli, the length of thalli was measured every 2 days, and the number of dead cells in a thallus were counted under a microscope 4-10 days after the start of the culture followed by an erythrosine staining. Initial chlorine concentrations which manifested a 50% growth effect and 50% dead cell in chlorinated effiuent-dosed culture and chlorinedosed diluted PES culture were 0.025-0.035 mg Cl2/1 and 0.06 mg Cl2/1 and 0.75-0.95 mg Cl2/1 and 1.5-3 mg Cl2/1, respectively. The growth effect and dead cell manifestation were dependent on the initial chlorine concentrations in both cultures. The amperometric method showed that the chlorine was free chlorine in the diluted PES culture and combined chlorine in the effluent-dosed culture. Although both residual chlorines disappeared with the passage of time, the removal rate of combined chlorine was slower than that of free chlorine. The strong toxicity may be caused by the reaction products of chlorine with organic substances in the effluent. (Author's abstract) W88-08881

STUDY ON THE SHAKING CULTURE METHOD TO EVALUATE THE EFFECT OF MUNICIPAL SEWAGE ON THE GROWTH OF PORPHYRA YEZOENSIS, (IN JAPANESE), Tokyo Univ. of Fisheries (Japan).

T. Maruyama, A. Miura, and T. Yoshida. Nippon Suisan Gakkashi NSUGAF, Vol. 53, No. 12, p 2227-2234, December 1987. 7 fig. 1 tab, 20 ref.

Descriptors: *Rhodophyta, *Municipal wastewater, *Wastewater treatment, *Activated sludge process, *Wastewater pollution, *Phytotosicity, *Effluents, Growth, Porphyra yezoensis, Thallus, Shaking culture method, Static culture method.

The effects of effluents from municipal sewage The effects of effluents from municipal sewage treatment plants on the growth of Porphyra yezoensis was studied by comparing the shaking culture method with the static culture method. Effuents examined were sampled before chlorination, and Provasoli's enriched seawater (PES) was used as a control. To clarify the differences in effects between shaking and static cultures on the growth of Porphyra thalli, the thalli length and the absorption spectra of living thalli large measured. absorption spectra of living thalli were measured on the second day. The number of dead or diseased cells in a thallus was observed under a microscope followed by erythrosine staining after 10 to 12 days from the start of the culture. The ranges of relative length of the thalli (1.8-4.9 and 1.3-2.1) were oblength of the thalli (1.8-4.9 and 1.3-2.1) were obtained after 10 days in effluents, with a salinity of 31 o/oo by shaking or static cultures, respectively. The maximum relative length of thalli (5.8) was obtained after 10 days in a forty-fold diluted PES medium, with a salinity of 31 o/oo by shaking culture. The shaking culture method showed a higher sensitivity than the static culture method for other aspects examined regarding the effect of the effluent on the growth of Porphyra thalli. (See also W88-08890) (Author's abstract) W88-08889 W88-08889

STUDIES OF THE SAMPLING TIME OF THE EFFLUENT OF THE MUNICIPAL SEWAGE TREATMENT PLANT TO EVALUATE THE EF-

TREATMENT PLANT TO EVALUATE THE EFFECTS ON THE GROWTH OF PORPHYRA YEZOENSIS, (IN JAPANESE), Tokyo Univ. of Fisheries (Japan).
T. Maruyama, A. Miura, and T. Yoshida.
Nippon Suisan Gakkaishi NSUGAF, Vol. 53, No. 12, p 2235-2241, December 1987. 7 fig, 5 ref.

*Rhodophyta, Descriptors: wastewater, *Wastewater treatment, *Activated sludge process, *Wastewater pollution, *Phytotoxicity, *Effluents, Porphyra yezoensis, Thallus.

Daily and weekly sampling times were investigated in a study of the effects of unchlorinated activated sludge effluent from a municipal sewage plant on the growth of Porphyra yezoensis using an in vitro shaking culture. Effluents examined were sampled, before the chlorination occurred in were sampled, sectore the chromation occurred in the sewage plant every 2 hours in one day and every day at 15:00 for one week. To clarify the difference in the effects on the Porphyra thalli, the thalli length and the absorbance spectra were measured, and dead cells were observed. Hourly sampled effluents (Thursday-Friday) were classified roughly into 3 time zones from a standpoint of the effects on the growth of Porphyra thalli, they were 11:00-17:00, 21:00-5:00 of the next day and transition time zone, Effluent sampled daily at 15:00 were classified roughly into 3 types from the standpoint of the growth of Porphyra thalli: samples collected from Tuesday to Friday, on Saturday, and from Sunday to Monday. Normally, the sampling time zone and day of the week for evaluating the effects of activated, unchlorinated effluent may be (i) 13:00-17:00 on Sunday, on Monday, and on one of the days from Tuesday to Thursday, and (2) 23:00-1:00 of the next day on Sunday and on one of the days from Tuesday to Friday. (See also W88-08889) (Author's abstract)

5F. Water Treatment and **Ouality Alteration**

OVERHAULING HEALTH EFFECTS PER-SPECTIVES.

Colorado Springs Dept. of Utilities, CO. G. H. Schwebach, D. Cafaro, J. Egan, M. Grimes, and G. Michael.

Journal Water Pollution Control Federation JWPFA5, Vol. 60, No. 4, p 473-479, April 1988. 1 tab, 15 ref.

Descriptors: *Water reuse, *Municipal wastewater, *Wastewater irrigation, *Public health, *Irrigation water, *Parks, *Public waters, *Coliforms, Runoff water, Human diseases, Gastrointestinal disease,

In considering the permit renewal for discharge at the wastewater treatment facility of Colorado Springs, the Colorado Dept. of Health (CDH) was concerned about health effects on visitors active in parks that were irrigated with nonpotable water of wastewater origin. While the CDH held that a standard of <2.2 total coliforms per 100 mL for the nonpotable water was needed, the city held that the existing standard of <200 fecal coliforms per 100 mL as a weekly exponentic mean posed no that the existing standard of <200 fecal coliforms per 100 mL as a weekly geometric mean posed no greater health risk than the more stringent proposed standard; this standard would pose an unnecessary financial burden on the city. This conflict was resolved when the city offered to conduct an epidemiology study designed to prove or disprove the hypothesis that gastrointestinal illness rates at parks irrigated with potable water were no different from illness rates reported at parks irrigated. parts irrigated with potatole water were no different from illness rates reported at parks irrigated with nonpotable water of wastewater origin. The 2-year study, which consisted of 2642 subjects randomly selected and analyzed, used bivariate statistical analysis. The data indicated that there was no difference in self-reported gastrointestinal illness state between there unit to recognition in earlier unit. was no difference in self-reported gastrointestinal lilness rates between those visitors in parks watered with potable water versus those watered with nonpotable water of either wastewater or runoff origin. This finding meant that the treatment level used in the past, which was designed to achieve a regulatory policy criterion of 200 fecal coliforms per 100 mL, was adequate and did protect the public health. The nonpotable water used for irrigating public parks was as safe as potable water. (Sand-PTT) W88-08003

APPLICATION OF INVESTMENT TIMING ANALYSIS: DUAL WATER SYSTEMS,

Marsan (Andre) et Associes, Inc., (Quebec). For primary bibliographic entry see Field 3C.

W88-08029

DERIVING THE NONLINEAR RISK-BENEFIT ALGORITHM FOR RESERVOIRS,

Mahidol Univ., Bangkok (Thailand). Dept. of Environmental and Resource Studies. For primary bibliographic entry see Field 6A. W88-08031

RESIDENTIAL WATER DEMAND IN METRO MANILA,

For primary bibliographic entry see Field 6D.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration-Group 5F

HANDPUMP PROJECTS: AVOIDING NE-GLECT, C. van Wijk, and J. T. Visscher. Water Resources Journal, No. 155, p. 69-72, De-

Descriptors: "Handpumps, "Maintenance, "Water supply systems, "Drinking water, Economic as-pects, Community development.

In planning and construction to improve drinking water supply and sanitation, the community plays a crucial role, as its members will have to use the facilities and in many cases will also have to contribute to maintenance and maintenance financing. In a handpump-based system each neighborhood using a particular handpump or protected well will be responsible for their own facility, including upkeep and financing of maintenance and repair, while the local government or community water committee assists in resolving any problems beyond the group's capacity. An advantage of this system is that there are often close social ties and a greater sense of ownership within smaller neighborhoods sharing a communal facility so that social control and arrangements for equitable payments may be easier to achieve. A disadvantage is that there will be no automatic cross-subsidy when some neighborhoods have more problems of breakdown beyond their control, such as those caused by a higher aggressiveness of the well water. Community-based management forms part of a total system, whose parts should be mutually adapted and equally developed. Handpumps should be suitable for maintenance and repair by trained caretakers or mechanics, spares and tools should be readily available and affordable, training given on technical, financial and organizational aspects, and effective community control. (Alexander-PTT)

SURVEY OF RESIDUAL ALUMINUM IN FIL-

SURVEY OF RESIDUAL ALUMINUM IN FIL-TERED WATER, Syracuse Univ., NY. Dept. of Civil Engineering. R. D. Letterman, and C. T. Driscoll. Journal of the American Water Works Association JAWWA5, Vol. 80, No. 4, p 154-158, April 1988. 2 fig, 6 tab, 15 ref.

Descriptors: *Water treatment, *Aluminum, *Sur-Descriptors: "water treatment, "Alumnum, "Sur-veys, "Water pollution sources, Congulation, Chemical coagulation, Chemical treatment, Alum, Particulate matter, Raw water, Filtration, Lime, Hydrogen ion concentration, Utilities, United States, Performance evaluation.

This article reports results of a survey of water utilities in the United States that use alum as a coagulant and have measured the concentration of total aluminum in their filtered water. Survey results suggest that effective removal of particulate matter minimizes residual aluminum levels, espeinatter minimizes residual auminum teveis, espe-cially when raw water contains elevated concen-trations of total aluminum. The results further indi-cate that lime used for pH adjustment following filtration may be an important source of residual aluminum. (Author's abstract) W88-08125

POLYELECTROLYTE CHARACTERISTICS

POLYELECTROLYTE
AND FLOCULATION,
Pennsylvania State Univ., University Park. Dept.
of Civil Engineering.
R. Leu, and M. M. Ghosh.
Journal of the American Water Works Association
JAWWA5, Vol. 80, No. 4, p 159-167, April 1988. 9
fig, 4 tab, 32 ref. EPA Grant R809807010.

Descriptors: *Water treatment, *Polyelectrolytes, *Floculation, Electrical properties, Molecular structure, Cations, Particle size, Mixing, Polymers, Mathematical models, Prediction.

The relationships among the characteristics of cationic polyelectrolytes, mixing conditions, and floculated particle size distribution were studied in an attempt to develop a rational basis for selecting polyelectrolytes. Charge density was found to be the predominant factor in selecting an optimum dosage of polyelectrolyte for flocculating particles with a primary charge opposite to that of the

polyelectrolyte. The initial periods of both rapid and slow mixing are critical in the formation of flocs. Large, strong flocs were obtained with high-molecular-weight polymers. A simplified model was developed to predict the average floc size based on the molecular weight of the polyelectrolyte and the mixing intensity. (Author's abstract) W88-08126

COMPARING ALUMINUM AND IRON CO-AGULANTS FOR IN-LINE FILTRATION OF COLD WATER, IOWA State Univ., Ames. Dept. of Civil Engineer-

ing.
J. Haarhoff, and J. L. Cleasby.
Journal of the American Water Works Association
JAWWAS, Vol. 80, No. 4, p 168-175, April 1988. 9
fig, 5 tab, 9 ref, append.

Descriptors: *Water treatment, *Coagulation, *Chemical coagulation, *Aluminum sulfate, *Iron compounds, *Filtration, Water temperature, Turbidity, Head loss, Clogging, Alum.

Pilot studies showed that with water temperatures less than 37 F (3 C) and raw water turbidities less than 2 NTU, ferric chloride removed turbidity more efficiently than did aluminum sulfate but that aluminum sulfate caused slower head-loss development. The total clogging head loss at the onset of turbidity breakthrough, however, was approximately the same for both coagulants. Equivalent head-loss development and turbidity removal were demonstrated at a molar iron-to-aluminum dosage ratio of 3:5.6. (Author's abstract)

ALUMINUM-FULVIC ACID INTERACTIONS: MECHANISMS AND APPLICATIONS, Johns Hopkins Univ., Baltimore, MD. T. R. Hundt, and C. R. O'Melia. Journal of the American Water Works Association JAWWA5, Vol. 80, No. 4, p 176-186, April 1988. 16 fig. 3 tab, 34 refs. EPA Grants R80814 and R810094.

Descriptors: "Water treatment, "Chemical treatment, "Chemical coagulation, "Coagulation, "Aluminum, "Fulvic acids," Ions, Alum, Polyaluminum chloride, Aluminum chloride, Hydrogen ion concentration, Chemical precipitation, Adsorption, Calcium, Electrical properties.

The process of fulvic acid coagulation using aluminum coagulants (alum, polyaluminum chloride, and aluminum chloride) was studied in order to improve fulvic acid removal during water treatment. The mechanism of fulvic acid removal is directly related to the form of aluminum in solution. The presence of different aluminum species causes removal of fulvic acid by different reaction mechanisms, depending on the pH, coagulant dosage, and fulvic acid concentration; specific conditions and aluminum species that exist during the charge neutralization-precipitation, adsorption, and simultaneous precipitation reaction mechanisms are discussed. Calcium enhances fulvic acid removal over a wide range of pH values. (Author's abstract) W88-08128

MECHANISMS OF COAGULATION WITH ALUMINUM SALTS, Cornell Univ., Ithaca, NY. S. K. Dentel, and J. M. Gossett. Journal of the American Water Works Association JAWWA5, Vol. 80, No. 4, p 187-198, April 1988. 21 fig. 2 tab, 40 ref. NSF Grants CME-7923267 and ECE-8504898.

Descriptors: "Water treatment, "Chemical treatment, "Chemical coagulation, "Coagulation, "Aluminum compounds, "Ions, "Electric charges, Model studies, Mathematical models, Electrical properties, Charge neutralization, Chemical speciation, Solubility, Adsorption, Particulate matter, Suspended solids, Colloids, Aluminum hydroxide, Iron compounds, Alum, Hydrogen ion concentration

A model is developed that describes the charge-neutralization aspects of coagulation, based on fun-

damental equations describing aluminum speciation and solubility, particle electro-double-layer characteristics, and the effect of aluminum-hydroxide teristics, and the effect of aluminum-hydroxide deposition on the surfaces of colloidal or suspended particles. Model predictions are compared with results from closely controlled jar-test experiments employing the addition of aluminum salts to synthetic suspensions, with good agreement under most conditions. The model's success suggests that these next substitutions are conditions. most conditions. The model's success suggests that charge neutralization coagulation can be explained as the partial coverage of negatively-charged particles by positively-charged aluminum hydroxide. Predicted conditions of pH and coagulant dosage for optimal destabilization of typical raw waters correspond with those recommended in practice, both for aluminum- and iron-salt coagulants. (Author's abstract) W88.08179

BENCH-SCALE EVALUATION OF COAGULANTS FOR LOW TURBIDITY WATER,

Colorado Dept. of Health, Denver. D. R. Brink, S.-I. Choi, M. Al-Ani, and D. W.

Journal of the American Water Works Association JAWWA5, Vol. 80, No. 4, p 199-204, April 1988. 8 fig. 1 tab, 15 ref. EPA Cooperative Agreement CR80865-02.

Descriptors: *Water treatment, *Chemical treatment, *Testing procedures, *Chemical coagulation, *Coagulation, *Turbidity, Filtration, Water treatment facilities.

Because the conventional jar test is ineffective for determining optimal coagulant dosages for low-turbidity waters, utilities employing rapid-rate filtration of such waters may fail to maximize treatment efficiency for lack of a simple bench-scale test for determining coagulant dosage. Using terms useful to water-treatment plant operators, this article describes a simple bench-scale procedure for determining coagulant dosages for raws, water support of the process of the coagulation of the process of the coagulation of the process of the p determining coagulant dosages for raw-water sup-plies with turbidity levels of 1 NTU or less. The authors explain the protocol for their jar-filtration test and present documentation on test validity. (Author's abstract) W88-08130

NEW COMPOSITE CHARGED REVERSE OS-MOSIS MEMBRANE, Nitto Electric Co. Ltd., Osaka (Japan).

For primary bibliographic entry see Field 3A. W88-08137

NITRATE REMOVAL BY ELECTRODIALYSIS FOR BREWING WATER,

GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.) K. Kneifel, G. Luehrs, and H. Wagner. Desalination DSLNAH, Vol. 68, No. 2-3, p 203-209, March 1988. 3 fig, 5 tab, 2 ref.

Descriptors: *Water treatment, *Well water, *De-salination, *Membrane processes, *Electrodialysis, *Nitrates, Dissolved solids, Hardness, Water costs, Pilot plants, Desalination, Brewing water, Industri-

From the example of a pilot operation in a brew-ery, it is demonstrated that electrodialysis is a reasonable process for removing nitrate from well water. The initial salt content of the raw water was water. The initial salt content of the raw water was 600 ppm total dissolved solids including 50 ppm nitrate and the total hardness was about 8 millier quivalents per liter. Measurements indicate that after treatment the desired product water quality, i.e., 10 ppm nitrate and a residual hardness of about 2.5 milliequivalents per liter, was achieved. The plant had a capacity of 24 cubic meters per day and was operated mainly at a water recovery rate of 80%. The costs for nitrate removal in an industrial solar water estimated to be 0.75.1 00 Deutsch on ourse. The costs for nurse removal in an industrial plant were estimated to be 0.75-1.00 Deutschmarks per cubic meter product water, based on a plant capacity of 100 cubic meters per day. (Author's abstract)

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F-Water Treatment and Quality Alteration

WATER TREATMENT RELATED CHARAC-WAIER IREAIMENT RELAIED CHARACTERIZATION OF THE PHOTOCHEMICAL DEGRADATION PRODUCTS OF AQUATIC HUMIC SUBSTANCES (AUFBEREITUNGSORIENTIERTE ASPERTE DES PHOTOCHEMIS-CHEN ABBAUS AQUATISCHER HUMIN-STOFFE), Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneolo-

gie. H. Bauer, and F. H. Frimmel. Zeitschrift fuer Wasser- und Abwasser-Forschung ZWABAQ, Vol. 20, No. 4, p 118-122, August 1987. 9 fig, 14 ref.

Descriptors: *Water treatment, *Irradiation, *Ultraviolet radiation, *Humic acids, *Degradation, *Chemical degradation, Dissolved solids, Adsorption, Flocculation, Iron compounds, Chloroform.

The growing interest in ultraviolet irradiation for The growing interest in ultraviolet irradiation for water treatment necessitates detailed investigation of the photochemical reactions of water constituents. Humic substances deserve special attention. In an irradiation apparatus (a reactor with liquid circulation, low-pressure mercury lamp) samples of dissolved organic carbon (initial concentration 9.6 milligrams per liter) were irradiated for up to three hours. The spectral absorbances at lambda = 436 nanometers (yellow color) and lambda = 234 nanometers decreased with irradiation time more various properties of the properties of nanometers (yearow color) and namous = 239 nan-ometers decreased with irradiation time more rap-idly than the dissolved organic carbon. Increasing adsorption on activated carbon and decreasing elimination by Fe(III) flocculation was obtained. elimination by Fe(III) flocculation was obtained. The absolute value of the chloroform formation potential decreased with increasing irradiation time, whereas the specific values remained constant. Treatment-related parameters are of practical importance for the characterization of humic substances which cannot be described by exact molecular structures. (Author's abstract) W88-08152

EFFECT OF OZONATION ON THE IMPAIRMENT OF FLOCCULATION BY ALGOGENIC ORGANIC MATTER,

Wahnbachtalsperrenverband, Siegburg (Germany,

F.K.).
O. Hoyer, H. Bernhardt, and B. Luesse.
Zeitschrift fuer Wasser- und Abwasser-Forschung
ZWABAQ, Vol. 20, No. 4, p 123-131, August
1987. 9 fig, 3 tab, 28 ref.

Descriptors: *Chemical reactions, *Water treatment, *Ozonation, *Flocculation, *Algae, *Organic matter, Filtration, Organic acids, Humic acids, Alginic acids, Carboxylic acids.

Applications and effects of ozonation on flocculation and filtration processes for drinking water production are discussed and the literature is reviewed. Up to now, publications have dealt pre-dominantly with ozonation effects related to humic matter, while, practically speaking, algogenic or-ganic matter has also been found to be of rel-evance, at least with surface waters. Several kinds evance, at least with surface waters. Several kinds of algogenic organic matter, known to be typical in flocculation-interfering properties, were ozonized in an apparatus representing real operating conditions. Supplies of ozone in the range of 0-8 mg per mg carbon resulted in consumptions of 0-2 mg carbon. In all cases, consumptions of greater than 1 caroon. In all cases, consumptions of greater than ing ozoae per mg carbon resulted in increased flocculation impairment. Lower ozone consumptions were found to cause a reduction of impairment, but in one case low ozone doses increased flocculation impairment directly. Reaction mechanics insurance in the polymer acidities of the algogenic organic matter from ozonation, and changes in the effects on flocculation, are discussed and experimentally confirmed, using alginic acid as a model compound. The findings exclude an oxidaa model compound. The indings excisue an oxina-tive formation of carboxylic groups on the macro-molecule of the mainly polysaccharidic algoginic organic matter. It seems, however, that in a first step, ozone leads to a degradation to monomers, but without formation of acidic carboxylic groups. In a second step, the monomers are further oxidized into carboxylic acids, which are known to cause significant impairment of flocculation. (Author's abstract) /88-08153

DETERMINATION OF ORGANIC GROUP PARAMETERS-AOCL, AOBR, AOS IN WATER BY MEANS OF ION-CHROMATOGRAPHIC DETECTION: ENRICHMENT OF MODIL SUBSTANCES AND ELIMINATION OF THE INORGANIC ANION ADSORPTION (BESTIMMUNG DER ORGANISCHEN GRUPPENPARAMETER AOCL, AOBR, AOS IN WAESSERN MIT IONEN-CHROMATOGRAPHISCHER DETEKTION: ADSORPTION ORGANISCHER MODELLSUBSTANZEN UND VERDRAENGUNG ANORGANISCHER ANIONEN AUF CHLOR- UND SCHWEFELFREIER AKTIV-KOHLE).

Gesamthochschule Paderborn (Germany, F.R.). Dept. of Applied Chemistry.
For primary bibliographic entry see Field 5A. For primary W88-08154

MATERNAL LITERACY MODIFIES THE EFFECT OF TOILETS AND PIPED WATER ON INFANT SURVIVAL IN MALAYSIA, Johns Hopkins Univ., Baltimore, MD. Dept. of International Health.

International Health.
S.A. Esrey, and J.P. Habicht.
American Journal of Epidemiology AJEPAS, Vol.
127, No. 5, p 1079-1087, May 1988. 5 tab, 22 ref.
USAID Grant OTR-2199, USAID Grant OTR1822. AID DSAN CA-0240.

Descriptors: *Plumbing, *Sanitation, *Public health, *Education, *Water supply, Developing countries, Infant mortality, Toilet, Malaysia, Statis-

The effects of toilets, piped water, and maternal literacy on infant mortality was analyzed using data from the Malaysian Family Life Survey collected in 1976-1977. The effect of toilets and piped lected in 1976-1977. The effect of toilets and piped water on infant mortality was dependent on whether or not mothers were literate. The impact of having toilets was greater among the iliterate than among the literate, but the impact of piped water was greater among the literate than among the literate con the infant mortality rate for toilets decreased from 130.7 plus or minus 17.2 plus or minus 2.5 9 deaths in the presence of literate mothers. The reduction in the mortality rate for plus or minus 25.9 deaths in the presence of literate mothers. The reduction in the mortality rate for maternal literacy dropped from 44.4 plus or minus 14.1 deaths without toilets to -10.1 plus or minus 14.1 deaths with toilets. Reductions in mortality rates for piped water increased from 16.7 plus or minus 12.7 deaths without literate mothers to 36.8 plus or minus 21.0 deaths with literate mothers to 36.8 plus or minus 21.0 deaths with literate mothers. Similarly, reductions in the mortality rate for maternal literacy rose from 44.4 plus or minus 14.1 deaths in the absence of piped water to 64.5 plus or minus 19.5 deaths in the presence of piped water. The results from a logistic model provided inferences similar to those from ordinary least squares. Literate mothers apparently protect their infants especially in unsanitary environments lacking toilets, and when piped water is introduced, they use it more effectively to practice better hygiene for their infants. (Author's abstract) W88-08156 W88-08156

DISINFECTION OF ANION EXCHANGE RESINS IN THE COMBINED ION EXCHANGE/BIOLOGICAL DENITRIFICATION PROCESS: PART I. EFFECT ON WATER

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control. J.P. Van Der Hoek, J. Verheijen, P.I.M. Vis, and

A: Klapwijk.

Zeitschrift fuer Wasser - und Abwasser Forschung
Vol. 20, No. 5, p 155-160, October 1987. 1 fig,
tab, 30 ref.

Descriptors: *Groundwater pollution, *Water pollution control, *Disinfection, *Nitrates, *Anion exchange, *Bacteria, *Contamination, *Denitrificachange, *Bacteria, *Contamination, tion, *Water quality management, Resins

Contamination of groundwater with nitrate is an Contamination of groundwater with intrate is a important problem in several European countries. The combined ion exchange/biological denitrifica-tion process is a technique for nitrate removal from groundwater. In this process the resins are regener-

ated with a biological denitrification reactor. How ever, this causes a bacterial contamination of the resins and the colony counts in the treated water will be increased by the resins. For that reason, the will be increased by the resins. For that reason, the resins have to be disinfected after regeneration during the rinse phase, before they are used for nitrate removal again. It was possible to reduce the colony counts in the treated water below 30/ml with the use of 0.075% peracetic acid for 15 min or 0.20% hydrogen peroxide for 45 min during rinsing. (See also W88-08164) (Author's abstract)

DISINFECTION OF ANION EXCHANGE RESINS IN THE COMBINED ION EXCHANGE/BIOLOGICAL DENITRIFICATION PROCESS. PART II: EFFECT ON RESIN PACITY.

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control. J.P. Van Der Hoek, P.J.M. Van Der Ven, and A.

Klapwijk.

Zeitschrift fuer Wasser - und Abwasser Forschung
ZWABAQ, Vol. 20, No. 6, p 193-196, December
1987. 5 fig. 2 tab, 13 ref.

Descriptors: *Water treatment, *Ion exchange, *Disinfection, *Nitrates, *Anion exchange, *Denitrification, Bacteria, Contamination, Resins, Drink-

In the combined ion exchange/biological denitrifi-cation process for nitrate removal from ground-water, the resins are regenerated in a closed system with a biological denitrification reactor. During regeneration the resins become bacteriologically polluted. To safeguard drinking water quality, the resins have to be disinfected with 0.075% peracetic resins have to elisinfected with 0.075% peracetic acid or 0.20% hydrogen peroxide, once during every process cycle of service and regeneration. With 0.075% peracetic acid, all 3 examined resins (Duolite A 165, Amberlite IRA 996, and Purolite (Duolite A 165, Amberlite IRA 996, and Purolite A 520) showed an important loss of capacity over the long term. It appears that with 0.20% hydrogen peroxide this could be avoided. Although the capacities of Amberlite IRA 996 and Purolite A 520, both nitrate-selective resins, were severely reduced, the nitrate selectivity was not changed by 0.75% peracetic acid. (See also W88-08158) (Author's abstract) W89-08164 W88-08164

PRECISE PH-MEASUREMENT IN DRINKING

WATER,
Wissenschaftlich-Technische Werkste
G.m.b.H., Weilheim (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W88-08169

THERMAL PRESSURE DUE TO AN ICE CAP IN AN ELEVATED WATER TANK, Queen's Univ., Kingston (Ontario). Dept. of Civil For primary bibliographic entry see Field 2C. W88-08210

DESIGN RECOMMENDATIONS FOR REIN-FORCED CONCRETE CYLINDRICAL STOR-AGE STRUCTURES FOR AQUEOUS MATERI-

Guelph Univ. (Ontario). School of Engineering. For primary bibliographic entry see Field 8F. W88-08211

BAMBOO AND WOODEN PIPES.

T. N. Lipangile. AMBIO AMBOCX, Vol. 16, No. 5, p 299-301, 1987.

Descriptors: *Pipes, *Pipelines, *Conveyance structures, *Conduits, *Water storage, *Developing countries, *Storage tanks, Bamboo, Wood, Irrigation, Sewer systems, Tanzania.

Third World countries face acute shortages of a number of construction materials used for water conduits, e.g., pipes and tanks. Conventional mate-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration-Group 5F

rials such as plastic, steel and concrete must often be imported and thus are not feasible alternatives for developing countries. For the past decade, researchers in Tanzania have studied the possibility of utilizing forest products, e.g. bamboo and timber, to construct pipes for water conveyance and tanks for storage. The water available will be used for irrigation, sewage and culverts. The results achieved so far are promising. Tanzania now has more than 200 km of wooden and bamboo pipelines in 30 villages and about 100,000 people are being supplied with water from these structures. (Sand-PTT)

CADMIUM AND ZINC CONCENTRATIONS IN THE POTABLE WATER OF THE EASTERN PROVINCE OF SAUDI ARABIA, King Faisal Univ., Damman (Saudi Arabia). Coll. of Medicine and Medical Sciences. H. T. Mustafa, H. M. A. Hassan, A. Abo-Melha,

and T. Rihan

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 40, No. 3, p 462-467, March 1988. 1 fig, 3 tab, 5 ref.

Descriptors: *Cadmium, *Zinc, *Heavy metals, *Potable water, *Drinking water, *Metal pollutants, *Water quality, *Water analysis, Chemical analysis, Trace metals, Saudi Arabia, Aquatic pollution, Statistical methods, Water pollution effects,

Cadmium toxicity was studied together with zinc concentration in order to assess the magnitude of the harmful effects of cadmium. More than 300 water samples were collected from the seven major populated areas of the Eastern province of the Kingdom of Saudi Arabia. Cadmium and zinc concentration distributions were calculated. Out of 307 samples, 107, or 43.9%, exceeded the upper limit for cadmium, while 30 samples, or 11.4%, had cadmium concentrations more than twice as much as the accented levels. As for zinc concentration in cadmium concentrations more train twice as much as the accepted levels. As for zinc concentration in water, only two samples exceeded the upper limit of 5 mg/L and no harmful effects are expected from its presence in the drinking water at the levels indicated. It is concluded that the results will be more interesting when the studies of the relation ships between cadmium concentration alone and in conjunction with zinc in drinking water and trends of cardiovascular morbidity in the population con-suming this water are completed. (Miller-PTT) W88-08250

LEGIONNAIRES' DISEASE ASSOCIATED WITH A HOSPITAL WATER SYSTEM: A FIVE-YEAR PROGRESS REPORT ON CONTINU-OUS HYPERCHLORINATION, Iowa Univ., Iowa City. Coll. of Medicine. C. M. Helms, R. M. Massanari, R. P. Wenzel, M. A. Pfaller, and N. P. Moyer.
Journal of the American Medical Association JAMAA, Vol. 259, No. 16, p 2423-2427, April 1988. 2 tab, 50 ref.

Descriptors: *Contamination, *Human diseases, *Epidemiology, *Infection, *Disinfection, *Chlorination, *Water treatment, *Water pollution sources, *Legionnaires' disease, Drinking water, Potable water, Population effect, Population exposure, Legionella, Chlorine, Trihalomethanes, Carcinogens, Water distribution, Corrosion damage, Performance evaluation, Microbiological studies.

In 1981, sixteen cases of nosocomial legionellosis occurred among 456 patients admitted to a new hematology-oncology unit (35 per 1000 admissions). Monoclonal antibody typing and restriction endonuclease plasmid analysis identified a unique strain (09,04) of Legionella pneumophila serogroup 1 isolated from both patients and water outlets. Continuous hyperchlorination of the hot and cold water began in January 1982 and chlorine leavels of water began in January 1982, and chlorine levels of water samples have been maintained most recently. Water samples have been consistently negative for Legionella for more than five years. Four sporadic cases of nosocomial legionellosis have occurred in the hematology-oncology unit during the same period (one per 1000 admissions) associated with a different strain of Legionella pneumophila sero-

group 1 (09,00). The environmental reservoir(s) of L. pneumophila serogroup 1 in these cases has not been identified. Levels of trihalomethanes (potential carcinogens) were high (>100 micrograms/L) when chlorine levels of hot water exceeded 4 mg/L. When controlle levels of not water exceeded 4 might L. Some corrosion damage to the water distribu-tion system has occurred: the average number of leaks per month increased steadily from zero in 1982 to 5.2 in 1986. The chlorinator installation 1992 to 3.2 in 1996. The cinorinator instantation costs were \$75,800, and annual operation expenses were \$12,500. Continuous hyperchlorination is a promising but still experimental technique for control of nosocomial legionellosis. The results indicate that the epidemic disease is controlled, but sporadic cases continue to occur. (Author's absporadic cases continue to occur. stract) W88-08309

NEW METHODOLOGY FOR MODELLING BREAK FAILURE PATTERNS IN DETERIORATING WATER DISTRIBUTION SYSTEMS: THEORY, General Motors Research Labs., Warren, MI.

General Motors Research Labs., Warren, MI. S. A. Andreou, D. H. Marks, and R. M. Clark. Advances in Water Resources AWREDI, Vol. 10, No. 1, p 2-10, March 1987. 13 ref, 2 append. EPA Grant CR810558-01-0.

Descriptors: *Water conveyance, *Water distribu-tion, *Pipes, *Pipelines, *Water mains, *Deteriora-tion, Mathematical models.

The need to consider two separate stages of deterioration (early stages with fewer breaks and late stages with multiple breaks) in water distribution systems is identified. Based on the results of two case studies, a proportional hazards model is used to represent the early stages of deterioration, while a Poisson-type model describes the late stages (associated with multiple and frequent breaks). The techniques focus with great detail at the individual pipe level by letting the hazard rate depend on covariates reflecting various pipe and environmental characteristics. Failure probabilities are estimated nonparametrically. Consequently, we do not need to priori hypothesize the functional form of the break-rate/pipe-age relationship. (See also W88-08336) (Author's abstract)

NEW METHODOLOGY FOR MODELLING BREAK FAILURE PATTERNS IN DETERIORATING WATER DISTRIBUTION SYSTEMS:

RATING WATER DISTRIBUTION SYSTEMS: APPLICATIONS, General Motors Research Labs., Warren, MI. S. A. Andreou, D. H. Marks, and R. M. Clark. Advances in Water Resources AWREDI, Vol. 10, No. 1, p 11-20, March 1987. 2 fig. 10 tab, 3 ref, 2 append. EPA Grant CR810558-01-0.

Descriptors: *Water distribution, *Pipes, *Pipelines, *Water mains, *Water conveyance, *Deterioration, Mathematical models.

In two case studies Proportional Hazards and Pois-In two case studies Proportional Hazards and Poisson-type models are applied to predict failure probabilities in deteriorating water pipes. Breaks follow a nonhomogeneous Markov Process during the early stages of deterioration, i.e., the failure probability is a function of time and also depends, among other things, on the number of previous breaks. During the later stages of deterioration a constant, but highly varying among pipes, break rate characterizes the failure pattern. In this latter case breaks could be reasonably approximated as Poisson arrivals. The results help in identifying factors that contribute to increased break rates and provide a ais. The results nelp in identifying factors that contribute to increased break rates and provide a high level of detail necessary for understanding failure pattern variability at the individual pipe level. The proposed methodologies are expected to provide a useful quantitative tool for improving maintenance strategies. (See also W88-08335) (Author's abstract) W88-08336

EFFECT OF PH ADJUSTMENT ON THE IN TERNAL CORROSION RATE OF RESIDEN-TIAL CAST-IRON AND COPPER WATER DIS-TRIBUTION PIPES,

ique, Montreal (Quebec). Dept. of

Civil Engineering.
L. Millette, and D. S. Mavinic. Canadian Journal of Civil Engineering CJCEB8, Vol. 15, No. 1, p 79-90, 1988. 11 fig, 3 tab, 26 ref.

Descriptors: *Water distribution, *Domestic water, *Pipes, *Pipelines, *Corrosion, *Cast iron, *Copper, *Heavy metals, *Drinking water, *Hyen ion concentration, Lime.

The Greater Vancouver Regional District distributes drinking water that displays several attributes of an aggressive water: low pH, low alkalinity, and high dissolved oxygen. A study, consisting of two experimental sessions, was conducted to examine the effects of pH adjustment on internal corrosion the effects of pH adjustment on internal corrosion of residential cast-iron and copper water distribution pipes. Because of its aggressive nature, this water accelerates the corrosion of water pipes, which not only increases maintenance costs, but also encourages high levels of metal in the water. This last finding was confirmed by a preliminary survey wherein, after one month's sampling of six dwellings, it was found that the recommended maximum level of 1.0 mg/L was exceeded in 67% of the morning cold water first-flush samples. Adjustment of pH with hydrated lime, Cal(OH)2, was used for corrosion control. Cast-iron and copper used for corrosion control. Cast-iron and copper samples were exposed to pH-adjusted water for varying lengths of time, in two flow-through experimental systems (gravity-fed and system-pres-sure-fed). Although the corrosion rates were different for the two experimental sessions, analysis of the pH-related corrosion rates variation led to the same two findings. The corrosion rates of cast iron were 10 times those of copper; the increased pH enhanced these cast-iron corrosion rates by approximately 15%. However, a pH increase reduced copper corrosion by as much as 68%. The effects of increased pressure on corrosion were different for both metals; a higher pressure greatly enhanced cast-iron corrosion but had little effect on copper corrosion. (Author's abstract) W88-08362

SPATIAL AND TEMPORAL GROUPINGS OF WATER MAIN PIPE BREAKAGE IN WINNI-

Manitoba Univ., Winnipeg. Dept. of Civil Engi-

I. C. Goulter, and A. Kazemi.

Canadian Journal of Civil Engineering CJCEB8, Vol. 15, No. 1, p 91-97, 1988. 4 fig, 3 tab, 19 ref.

Descriptors: *Water distribution, *Water-main breakage, *Pipes, *Pipelines, *Water mains, Spatial distribution, Temporal distribution, Winnipeg, Canada.

The spatial and temporal patterns of water distri-Ine spatial and temporal patterns of water distri-bution pipe failure in the city of Winnipeg are examined. The failures are strongly clustered in space, where 22% of the total failures occur with 1 m of another failure and 46% occur within 20 m of m of another failure and 46% occur within 20 m of another failure. A strong temporal clustering is also apparent, with 42% of all failures that occur within 1 m of another found also to occur within 1 day of the initial failure in the group. An exponential decrease in the marginal rates of failure with respect to both the temporal and spatial interval parameter is also observed. Earlier failures in a particular location appear to be an important key. parameter is abordered. Earlier tainers in a particular location appear to be an important key to assessing potential failures in that vicinity. These results suggest that a fruitful area for further exam-ination for the reduction of failure rates is the change in the ground conditions resulting from an initial leak and its subsequent repair. (Author's abstract) W88-08363

SOIL EROSION AND WATER TREATMENT

Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology. D. L. Forster, C. P. Bardos, and D. D. Southgate.

Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 5, p 349-352, September-October 1987. 3 tab. 15 ref.

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F-Water Treatment and Quality Alteration

Descriptors: *Water treatment, *Cost analysis, *Soil erosion, *Erosion, *Path of pollutants, Ohio, Corn, Turbidity, Water treatment facilities.

The relationship between communities' water treatment costs and soil erosion is estimated. Twelve communities in Ohio's Corn Belt were selected for analysis. Independent variables, other then soil erosion, used in the analysis included treatment plant size, storage time of untreated water, and turbidity improvement due to water treatment. Results indicate that a 10% reduction in annual gross soil erosion results in a 4% reduction in annual water treatment costs. For Ohio commum annual water treatment costs. For Ohio commu-nities, reduced annual water treatment costs would total \$2.7 million, with a 25% reduction in soil erosion. (Author's abstract) W88-08381

METAL ABSORPTION BY MODIFIED CHITINS,

Ancona Univ. (Italy). Faculty of Medicine.
R. A. A. Muzzarelli, and R. Rocchetti.
IN: Trace Metal Removal from Aqueous Solution. In: 1 race Metal Removal from Aqueous Solution. The Proceedings of a Symposium Organized by the Industrial Division of the Royal Society of Chemistry as part of the Annual Chemical Congress, University of Warwick, April 9-10, 1986. The Royal Society of Chemistry, London. Special Publication No. 61, 1986. p 44-57, 2 fig., 4 tab, 28

Descriptors: *Metals, *Water treatment, *Chitins, *Absorbtion, *Chitosan, Chelation, Chemical treatment, Chemical reactions, Glucans, Heavy metals,

Chitosan, an effective chelating agent, when used as such for the removal of metal ions from natural waters, enters into competition with other natural chelating substances occurring in soluble forms in the waters. Chemical modifications leading to the introduction of an amino acid function into the glucan backbone, dramatically improves the che-lating ability of chitosan, one of the most effective lating ability of chitosan, one of the most effective derivatives being the glycine glucan. By taking advantage of the examples offered by natural pro-teic substances occurring in algae, fungi and ani-mals, the chitosan derivatives can be further modi-fied to yield oligopeptide glucans, where the oligo-peptide chains mimic or reproduce the fragment responsible for maximum chelating effect. Com-plete metal recovery is possible only when oxida-tive destruction of organic matter is carried out with nexulfate as a negliminary stem. In fact tive destruction of organic matter is carried out with persulfate as a preliminary step. In fact, metals occur in sea water in the following three chemical forms: (1) free hydrated ions; (2) ions forming weak complexes less stable than the chitosan metal chelates; and (3) ions strongly complexed ions are not retained by chitosan columns, while free and weakly-compleded are collected by chitosan from untreated sea water. It appears that chitosans with varying degrees of deacetylation, are ideal hydrophilic backbones to support amino-acid substituents or oligopeptides linked to C2 through the nitrogen atom. The proper selection of amino acid sequences would confer the polymer unique and unmatched chelating properties. (See also W88-08398) (Lantz-PTT) W88-08398) (Lantz-PTT)

TRANSFER BY SOLID-SUPPORTED LIQUID MEMBRANES,

Minnesota Univ., Minneapolis. Dept. of Chemistry. For primary bibliographic entry see Field 5D. W88-08403

PRICING OF WATER SERVICES.

Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 6C.
W88-08414

SAFE DRINKING WATER ACT COST IM-PACTS ON SELECTED WATER SYSTEMS,

CWC-HDR, Inc., Santa Ana, CA.
For primary bibliographic entry see Field 5G.
W88-08428

BACTERIA ATTACHED TO GRANULAR ACTI-VATED CARBON IN DRINKING WATER, Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab. G. A. McFeters, A. K. Camper, M. W. LeChevallier, S. C. Broadaway, and D. G. Davies. Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-228763. Price codes: A02 in paper copy, A01 in microfiche. EPA Environmental Research Brief No. EPA/ 600/M-87/003, June 1987. 5 p, 2 fig, 2 tab, 8 ref.

Descriptors: *Bacteria, *Granular activated carbon, *Bacterial analysis, *Drinking water, *Water treatment, Microbiological studies, Filters, Coliforms, Turbidity.

Laboratory and field studies were undertaken to Laboratory and need studies were undertaken to answer basic questions about the influence of granular activated carbon (GAC) on the bacterio-logical quality of drinking water. A sampling appa-ratus consisting of a 47-mm Swinnex and a 16-layer ratus consisting of a 47-mm Swinnex and a 16-layer gauze filter was developed to trap filter fines from large volumes of water. A desorption technique (Zwittergent 3-12, 0.00001 M; EGTA, 0.001 M; peptone, 0.01%; Tris buffer, pH 7.0, 0.1 M; homogenized at 4 °C for 3 min at 16,000 rpm) combined with optimal culturing procedures (heterotrophs, R2A medium at 28 °C for 7 days; coliforms, mT7 medium MF procedure and an MPN with lauryl sulfate added after 4 hr of incubation) allowed for the enumeration of particle-associated bacteria. sulfate added after 4 hr of incubation) allowed for the enumeration of particle-associated bacteria. The following conclusions were drawn: (1) GAC-attached bacteria were effectively removed by this desorption technique; (2) HPC, coliform, and en-teropathogenic bacteria grown on GAC or at-tached for less than a generation time were not killed by exposure to chlorine (2 mg/L) for 1 hr; (3) Enteropathogenic bacteria were capable of colonizing laboratory-scale GAC filters. Persist-ence of the pathogens depended on the presence of autochthonous surface water organisms; (4) Popu-lated GAC filter lines were found in drinking water from properly operated treatment facilities. from properly operated treatment facilities water from properly operated treatment facilities, and (5) Increasing the applied water turbidity, flow rate, and filter depth all caused an appearance of (a) a higher number of released particles; (b) increased bacterial colonization of the particles; and (c) elevated adsorbed coliforms. GAC supported more coliforms than sand or anthracite in laboratory experiments. (Lantz-PTT) W88-08430

WATER REUSE SYSTEMS: A REVIEW OF PRINCIPAL COMPONENTS, Fish and Wildlife Service, Cook, WA. Willard Field Station.

For primary bibliographic entry see Field 3C. W88-08544

PROTOTYPE WATER REUSE SYSTEM, Fish and Wildlife Service, Cook, WA. Willard Field Station. For primary bibliographic entry see Field 3C. W88-08545

IS FEDERAL FUNDING THE ANSWER TO WATER SUPPLY NEEDS, Smith and Loveless, Inc., Lenexa, KS. For primary bibliographic entry see Field 5G. W88-J8551

DRINKING WATER ACT: A CAUSE FOR IN-NOVATION, For primary bibliographic entry see Field 6E. W88-08552

CAN THE WATER ADDITIVES PROGRAM MEET THE STRUGGLE OF SELF REGULA-

mith (A.O.) Harvestore Products, Inc., DeKalb, For primary bibliographic entry see Field 6E. W88-08553

POLYCHLORINATED DIOXIN AND FURAN DISCHARGE DURING CARBON REACTIVA-

Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab. For primary bibliographic entry see Field 5B. W88-08571

THREAT TO THE NEW YORK CITY WATER SUPPLY - PLUTONIUM, Department of Energy, New York. Environmental

surements Lab. For primary bibliographic entry see Field 4C. W88-08605

REMOVING IMPEDIMENTS TO WATER

Brigham Young Univ., Provo, UT. Dept. of Eco-For primary bibliographic entry see Field 6C. W88-08618

ASSESSMENT OF WATER SUPPLY FOR AGRICULTURE IN THE NIGER RIVER BASIN DEVELOPMENT AUTHORITY AREA, NIGE-

RIA, Ife Univ. (Nigeria). Dept. of Geography. N. J. Bello.

Agricultural and Forest Meteorology, Vol. 40. No. 2, p 109-121, July 1987. 6 fig, 6 tab, 18 ref.

Descriptors: *Climatology, *Irrigation requirements, *Available water, *Niger River Basin, *Agriculture, *Evapotranspiration, Water supply, Seasonal variation, Regional analysis, Food crops, Irrigation, Rainfall.

Water supply for agriculture in the Niger River Basin area of Nigeria was assessed by formulating the humidity reference number using rainfall, actual and potential evapotranspiration data. From the humidity reference number, lengths of the periods of effective water availability and water deficiencies were determined. It is observed that the southern parts of the basin area have a higher potential for agriculture because of longer periods of effective moisture availability compared with the northern parts. The lengths of the periods of effective moisture availability and average rainfall during these periods were respectively related to effective moisture availability and average rainfail during these periods were respectively related to the length of the growing season and the moisture requirements of some selected crops. Some crops whose growth appeared not feasible in some parts of the basin area on the basis of the relationships between their lengths of growth and the duration of the moist periods were shown to be potentially feasible when their moisture requirements were considered in relation to average rainfall during the moist periods. The study showed that irrigation development is necessary in the basin area as a whole but there is much higher need for irrigation in the north. (Author's abstract) W88-08626

COMPREHENSIVE LOOK AT WATER TREAT-

J. Chandler. Water Well Journal WWJOA9, Vol. 42, No. 5, p 33-37, May 1988. 2 tab.

Descriptors: *Water treatment, *Water quality standards, *Drinking water, *Water analysis, *Marketing, Installation, Domestic water, Chemical analysis, Economic aspects, Physical analysis, Pollutants, Water softening, Training.

There are a myriad of water problems but, fortu-nately, solutions to many of them do exist. A number of water well contractors have made water treatment a significant part of their business and are now reaping profits while simultaneously making their customers happy with a good supply of quality water. Basic technical information and suggestions to water well contractors are made. Categories of contaminants and water analysis op-Categories of contaminants and water analysis op-tions are listed as well as how to size water treat-ment equipment correctly. Tables of EPA drinking water standards and common water quality prob-lems and their causes are listed along with proper equipment selection. Methods of advertising that enable the water well contractor to inform poten-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

tial customers of his water treatment services in-clude contacting previous well customers, local newspaper and radio ads, appropriate yellow page listings, and public speaking. Finding a reputable manufacturer and wholesaler, and receiving the proper technical training will help ensure success. (VerNooy-PTT) W88-08655

INVESTIGATION INTO UNCONVENTIONAL SOURCES OF WATER FOR A PERI-URBAN/RURAL DISTRICT OF KWAZULU,

Natal Univ., Pietermaritzburg (South Africa). Dept. of Crop Science. P. G. Alcock, and E. Verster.

South African Journal of Science SAJSAR, Vol. 83, No. 6, p 348-352, June 1987. 3 fig, 4 tab, 27 ref.

Descriptors: *Water harvesting, *Rainfall, *Fog, *KwaZulu, *Rural areas, *Urban areas, Water quality, Economic aspects, Developing countries, Potable water.

Rainwater harvesting as well as fog interception Rainwater harvesting as well as fog interception techniques were investigated as alternative sources of potable water for the Inadi ward, Vulindlela district of KwaZulu. Results showed that the chemical and bacteriological water quality from both systems was good. Daily yields of the experimental rainwater harvesting units were satisfactory, although further work is required to establish optimum dimensions in large units, using concrete as a construction medium. Fog interception, however, is too periodic and expensive to be a viable supply option. (Author's abstract) W88-08852

RESULTS OF THE QUESTIONNAIRE CON-CERNING THE USE OF DOMESTIC WATER-METERS (RESULTATS DU QUESTIONNAIRE CONCERNANT L'UTILISATION DES COMP-TEURS A EAU DOMESTIQUES),

For primary bibliographic entry see Field 6C. W88-08919

COMPUTER UTILIZATION IN DISTRIBU-TION (L'UTILISATION DES ORDINATEURS DANS LA DISTRIBUTION),

Keuringsinstituut voor Waterleidingartikelen, Rijs-wijk (Netherlands). J. T. VanDerZwan

Aqua AQUAAA, No. 1, p 9-13, January 1988. 7

Descriptors: *Design criteria, *Management planning, *Computers, *Computer programs, *Data acquisition, *Pipelines, *Water distribution, *Network design, Data bases, Social aspects.

This article considers the use of computers for the design of new water distribution networks as well as the modification of existing pipeline network systems. A systematic approach, where there is substantial control of computer use is recommendsubstantial control of computer use is recommend-ed. The possible computer assistance with plan-ning, management and control tasks is analyzed. The importance of both subject and computer ex-perts in project groups is stressed and some social aspects (such as changes in working conditions) are discussed. Using computers to maintain pipeline networks (via data bases) and to make quick man-agement decisions is also discussed. (Miller-PTT) VBS.08207.

TECHNIQUES OF COLLECTING DATA FOR A STUDY OF ERRORS IN MEASUREMENTS IN WATER METERS (LES TECHNIQUES D'A-QUISITION DE DONNEES POUR L'ETUDE DES ERREURS DE COMPTAGE DANS LES COMPTEURS A EAU), X. Tort, M. Valls, J. Coll, and E. Asencio. Aqua AQUAAA, No. 1, p 14-17, January 1988. 3 fig, 3 tab, 3 ref.

Descriptors: *Water metering, *Service life, *Performance evaluation, *Sampling, *Error analysis, *Data collections, Experiment design, Theory of sampling, Errors.

The use of Theory of Design of Experiments (instead of the traditional Theory of Sampling) to approximate the life of a water meter is discussed. An explicative model of errors is used based on a series of variables: the age of the meter, the origin of the water, the recorded volume, the diameter, and the model. The study aimed to empirically point out the error of measurement for each of the variables without having to investigate their direct effects on the internal components of the meter. (Miller-PTT)
W88-08921

PREVENTION OF CONTAMINATION (PRE-VENTION DE LA CONTAMINATION), Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).

A. D. Hulsmann

Aqua AQUAAA, No. 1, p 18-22, January 1988. 5 fig. 1 tab.

Descriptors: *Drinking *Construction methods, Water, *Water pollution control, *Contamination, *Water distribution, *Pipelines, *Reservoirs, Hygiene, Public health, Rehabilitation, Standards.

A set of rules is presented that cover the prevention of contamination of drinking water during maintenance and renewal work on water distribution systems and drinking water reservoirs. These rules are based upon the belief that the most effective means of controlling contamination is to focus on prevention through cleanliness rather than through the use of disinfectants to reduce it. In order to promote hygienic rules, the authors advise giving information and instruction to both manual and supervisory staff. (Author's abstract) W88-08922

OPTIMIZATION UNDER CERTAIN CONDI-TIONS OF WATER SYSTEMS CONTAINING PUMPING STATIONS (OPTIMISATION DANS CERTAINES CONDITIONS DES RESEAUX D'EAU COMPORTANT DES STATIONS DE

nale Elettricita ed Acque, Rome da Con (Italy). P. MArtini

Aqua AQUAAA, No. 1, p 23-32, January 1988. 10 fig, 2 tab, 1 ref, Append.

Descriptors: *Optimization, *Water conveyance, *Pumping plants, *Hydroelectric plants, *Urbanareas, *Pipelines, Capitalization rate, Water demand, Pipe flow, Costs, Flow rate, Design crite-

When planning water supply systems which con-tain pumping or hydroelectric stations, determing the optimum diameter is conditioned by the uncertainty which affects almost all of the paramuncertainty which affects almost all of the parameters under consideration (capitalization rate, development of consumption, cost of energy). It follows that the range of uncertainty for the values of the diameters is generally larger than the intervals between two consecutive values of the standard series used by the water boards. A simple but exact method of optimization based on a graphic correlation between standard diameters and flow rate is discussed. The method of calculation described here considers: (1) seasonal fluctuations and progressive increase in demand; (2) analyses of areas of uncertainty in economic and physical parameters; and (3) the consequent areas of uncertainty of the diameters, which are compared with discrete values corresponding to standard diameters used by water boards. (Author's abstract)
W88-08923

5G. Water Quality Control

ECOREGIONS: AN APPROACH TO SURFACE WATER PROTECTION, R. M. Hughes, and D. P. Larsen. Journal Water Pollution Control Federation JWPFAS, Vol. 60, No. 4, p 486-493, April 1988. 7 fig, 31 ref.

Descriptors: *Water quality management, *Water resources development, *Resources management,

Water Quality Control—Group 5G

*Ecosystems, *Water pollution, Maps, Aquatic environment, Biological properties.

Progressive water resource management requires objective goals and criteria to measure attainment of those goals. The concept of ecological regions or ecoregions can provide a logical framework for establishing water quality goals. Ecoregions group naturally similar ecoaystems and thereby stratify attainable aquatic chemistry and biota into relatively similar areas. The regions are substantially less diverse than the entire nation or a state. Sites stratified by ecoregion have similar ecological properties. diverse than the entire nation or a same. Since stratified by ecoregion have similar ecological po-tentials that can be quantified with known levels of precision. Attainable quality then is based on as-sessment of conditions in minimally impacted refersessment of conditions in minimally impacted reference sites that characterize the region. The proposed regional approach provides a useful adjunct to national and site specific methods for establishing objective goals. This method utilizes an ecoregion map, which is a synthesis of existing maps of regional patterns in land-surface form, soil, potential natural vegetation, and land use. All four variables are important for determining aquatic ecosystem attributes such as water quality, flow regime, habitat structure, food source, and migration barriers. Biological attributes depend on these enviriers. Biological attributes depend on these envi-ronmental attributes. The map's usefulness was evaluated in a series of statewide case studies in Arkansas, Minnesota, Ohio, and Oregon. (Sand-WRR-DROOM

INFILTRATION AND WATER QUALITY ON RANGE SITES AT FORT STANTON, NEW MEXICO,

New Mexico State Univ., Las Cruces. Dept. of Animal and Range Sciences. For primary bibliographic entry see Field 4C. W88-08038

HANDPUMP PROJECTS: AVOIDING NE-GLECT,

For primary bibliographic entry see Field 5F. W88-08086

TIME SERIES ANALYSIS OF WATER QUALITY DATA FROM LAKE ONTARIO: IMPLICATIONS FOR THE MEASUREMENT OF WATER QUALITY IN LARGE AND SMALL LAKES,

Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs. For primary bibliographic entry see Field 2H. W88-08103

PUBLIC ACCEPTS STORMWATER CONTROL PLAN, BCM Engineers, Mobile, AL. For primary bibliographic entry see Field 4A. W88-08133

INJECTING AN OXYGEN FIX, Corps of Engineers, Savannah, GA. Savannah Dis-

G. Mauldin, R. Miller, J. Gallagher, and R. E. Speece. Civil Engineering CEWRA9, Vol. 58, No. 3, p 54-56, March 1988. 2 fig.

Descriptors: *Water pollution treatment, *Oxygenation, *Reservoirs, *Dams, *Hypolimnion, *Destratification, *Aeration, Georgia, Lakes, Dissolved oxygen, Oxygen, Oxygen depletion, Bubbles, Stratification, Oxygen diffusers.

Pure oxygen diffusers, placed along impounded water bottoms of the Richard B. Russell Dam near Savannah, Georgia, bring life to waters during summer stagnations. Like all deep lakes in the southeast. Russell Lake stratifies during the sumers; with no means to replenish dissolved oxygen consumed by biological and chemical activity, DO levels in the depths of the lake—the hypolimnion layer—are gradually exhausted. Drexel University was contracted to research and recommend an was contracted to research and recommend an appropriate oxygenation scheme; 'hypolimnion

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oxygenation' was selected over lake destratificaoxygenation' was selected over lake destratification and downstream surface aeration for technical
and economic reasons. The diffuser system's two
1200-ft assemblies suspend 5 ft from the impoundment bottom, running 100 ft apart in parallel; a
second fine-bubble diffuser system boosts oxygentation during especially high flow or low Do
levels. Because of the high DO concentration
needed, 100% pure commercial oxygen which is
more efficiently absorbed than air, proved less
expensive. Gas analyses have shown that bubble
size greatly affects oxygen transfer; efficiencies
have averaged over 80% for small bubbles, below
50% for large bubbles. (Shidler-PTT)
W88-08142 W88-08142

MATERNAL LITERACY MODIFIES THE EFFECT OF TOILETS AND PIPED WATER ON INFANT SURVIVAL IN MALAYSIA, Johns Hopkins Univ., Baltimore, MD. Dept. of International Health. For primary bibliographic entry see Field 5F. W88-08156

DESIGNING OPTIMAL STRATEGIES FOR CONTAMINATED GROUNDWATER REMEDI-

ATION, Princeton Univ., NJ. Dept. of Civil Engineering. D.P. Ahlfeld, J.M. Mulvey, and G.F. Pinder. Advances in Water Resources AWREDI, Vol. 9, No. 2, p 77-84, June 1986. 2 fig. 3 tab, 18 ref, 2

Descriptors: *Water pollution treatment, *Mathematical models, *Plumes, *Waste storage, *Groundwater pollution, *Pumping, Pumps, Aquifers, Hazardous waste site.

The problem of locating pumps and setting pump rates to most effectively stabilize and remove a plume of contaminated groundwater at a hazard-ous waste site was examined. Nonlinear optimizaprume of contaminated groundwater at a hazardous waste site was examined. Nonlinear optimization methods were combined with convective-dispersive transport simulation in a unit response
matrix type of optimization formulation. Constraints were used which guarantee that the contaminant plume is removed by limiting the concentrations at nodal points in the domain at a future
time. Additional constraints explicitly require that
concentrations not increase in the area outside the
initial plume boundary. The effectiveness of alternative formulations were examined by performing
numerical experiments using a hypothetical aquifer. Computational costs are dominated by the
repeated simulations required for computation of
constraint gradients and are proportional to the
number of pump sites under consideration. This
characteristic of the formulation and algorithm
used, limits the use of the approach to problems
where the number of potential pump sites is relatively small. (Author's abstract)

ECOTOXICOLOGY: A FRAMEWORK FOR IN-VESTIGATIONS OF HAZARDOUS CHEMI-CALS IN THE ENVIRONMENT, Griffith Univ., Nathan (Australia). School of Aus-tralian Environmental Studies. For primary bibliographic entry see Field 5C. W88-08222

STREAM MANAGEMENT: EMERGING GLOBAL SIMILARITIES, Lund Univ. (Sweden). Stream and Bethic Ecology

Oroup.

R. C. Petersen, B. L. Madsen, M. A. Wilzbach, C. H. D. Magadza, and A. Paarlberg.

AMBIO AMBOCX, Vol. 16, No. 4, p 166-179, 1987.

Descriptors: *Streams, *Watershed management, *Agricultural watersheds, *Riparian waters, Water pollution, Air pollution, Economic aspects, Human diseases, Parasitism, Onchocerciasis, Denmark, Netherlands, Jamaica, Zimbabwe, United States, Human diseases, Public health, Acid rain.

Stream management throughout the world requires a holistic, ecosystem approach, that is partly

centered on stream riparian zones, but also involves fisheries management and factors external to the stream. The importance of the riparian zone as a buffer between the stream and watersheds is illustrated by examples from Denmark and The Netherlands where agricultural use of the water-Netherlands where agricultural use of the water-shed threatens surface-water quality. Additional examples from western Jamaica, Zimbabwe and the U.S. illustrate the ecological value as well as historical mismanagement of streams. The econom-ic value of riparian zones as nutrient filters is discussed, with examples from agricultural lands in Sweden. The importance of a holistic approach is illustrated by the onchocerciasis (river blindness disease) program in western Africa where disease control may threaten riparian zones and the world-wide introduction of exotic fishes which threatens indigenous species. The holistic approach is exmidgenous species. The holistic approach is ex-tended to a global perspective where factors wholly outside the watershed may effect streams. Examples are deforestation in western Africa that causes desertification in Zimbabwe and long-range transport of air pollutants that causes acidification of running waters in Scandinavia. (Author's ab-W88-08221

COASTAL EUTROPHICATION IN SWEDEN: REDUCING NITROGEN IN LAND RUNOFF, Halland County Administrative Board, Halmstad

S. Fleischer, S. Hamrin, T. Kindt, L. Rydberg, and AMBIO AMBOCX, Vol. 16, No. 5, p 246-251, 1987. 7 fig, 2 tab, 51 ref.

Descriptors: *Eutrophication, *Coastal waters, *Nitrogen, *Land use, *Water quality, *Kattegat, *Agriculture, Sweden, Plankton, Oxygen deficit, Bays, Catchment areas, Streams, Wetlands, Wetland rehabilitation, Stream rehabilitation.

land rehabilitation, Stream rehabilitation.

Eutrophication caused by excess nitrogen and the resulting plankton blooms in Kattegat have led to oxygen deficits in the bottom waters. Regional input of nitrogen affects southeastern Kattegat. The interdisciplinary project 'Land Use - Water Quality' has identified the main sources and transport routes of nitrogen in the drainage basin (10100 sq km) of Laholm Bay. Possible measures to decrease nitrogen loading in the coastal waters, such as increased spreading of manure in the springtime, are presented. A holistic approach includes measures that may also prove beneficial to a number of related agricultural problems, e.g., monotonous landscape (very few types of crops, decreasing grass- and wet-land areas), sensitivity to environmental catastrophes (atmospheric loading by radioactive materials or by chemicals), surplus production, and the threat to almost 200 wild plant species. In addition to direct agricultural measures, restoration of wetlands and streams is also necessary to reduce nitrogen losses to the coastal environment. (Author's abstract)

OVERVIEW OF STUDIES ON THE NUTRIENT STATUS OF LAKE ONTARIO, National Water Research Inst., Burlington (Ontar-

For primary bibliographic entry see Field 2H. W88-08269

RESPONSE OF LAKE ONTARIO TO REDUC-TIONS IN PHOSPHORUS LOAD, 1967-82, land Waters Directorate, Burlington (Ontario). Water Quality Branch.
For primary bibliographic entry see Field 2H.
W88-08271

DIFFERENCES BETWEEN NEARSHORE AND OFFSHORE PHYTOPLANKTON COMMUNI-TIES IN LAKE ONTARIO,

National Water Research Inst., Burlington (Ontar-For primary bibliographic entry see Field 2H.

REDUCTION OF CLADOPHORA BIOMASS AND TISSUE PHOSPHORUS IN LAKE ON-TARIO, 1972-83,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div. D. S. Painter, and G. Kamaitis.

Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 12, p 2212-2215, December 1987. 4 fig, 6 ref.

Descriptors: *Biomass, *Algae, *Limiting nutri-ents, *Lake Ontario, *Lakes, *Tissue analysis, *Phosphorus removal, Model studies, Net specific growth rate, Aquatic productivity, Spatial distribution, Cladoph

Cladaphora biomass and tissue phosphorus concentrations at seven sites in Lake Ontario have decreased from 1972 to 1983 in response to phosphorus control programs introduced in the early 1970s. Biomass and tissue phosphorus were significantly different between 1972 and 1982-83 (ANOVA, P different between 1972 and 1982-83 (AÑOVA, P < 0.001) but not significantly different between 1982 and 1983. The lakewide average tissue phosphorus was 0.49% in 1972 but by 1982 and 1983 had dropped to 0.26 and 0.20%, respectively, on an ash-free dry weight basis. Tissue phosphorus concentrations did not limit growth in 1972 but in 1983 had begun to limit growth Model-predicted net production for a 6-week sampling period in 1983 was 1.7 times greater in the western end of the lake than at a remote site in eastern Lake Ontario due to higher soluble reactive phosphorus concentrations. (Author's abstract) (Author's abstract) W88-08287

REMOVAL OF NICKEL (II) FROM WATER USING DECAYING LEAVES: EFFECTS OF PH AND TYPE OF LEAVES,

Al-Najah National Univ., Nablus (Jordan). Dept. of Chemistry. R. Salim.

Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 3, p 183-197, April 1988. 9 fig. 17 ref.

Descriptors: *Water pollution treatment, *Toxic wastes, *Heavy metals, *Nickel, *Path of pollutants, *Plant tissues, Hydrogen ion concentration.

Nickel has been known to be toxic. Water becomes contaminated with nickel via several sources. Thus developing ways for the removal of nickel from water is important. Leaves have been proven to be capable of removing nickel from aqueous solutions. This removal process is dependent on both pH and the type of leaves. Four common types of leaves have been studied over a wide range of pH. The best pH and type of leaves for the removal of nickel from aqueous solutions are discussed. (Author's abstract) thor's abstract) W88-08299

ANALYSIS OF INTERCEPTOR DITCHES FOR CONTROL OF GROUNDWATER POLLUTION, Wisconsin Univ.-Madison. Dept. of Geology and Geophysics

C. Zheng, H. F. Wang, M. P. Anderson, and K. R. Bradbury.
Journal of Hydrology JHYDA7, Vol. 98, No. 1/2, p 67-81, March 15 1988. 10 fig, 22 ref.

Descriptors: *Open-channel drainage, *Drainage ditches, *Water pollution prevention, *Groundwater pollution, *Path of pollutants, *Model studies, Groundwater movement, Hydraulic conductivity, Ditches, Aquifers, Mathematical models.

The concept of the dividing surface and streamling The concept of the dividing surface and streamline was used to delineate groundwater flow which is intercepted by partially penetrating ditches. The depth of the dividing surface or dividing streamline was used to quantify the degree to which the ditches act as hydraulic barriers to limit the spread of contaminated groundwater in shallow water table aquifers under steady-state conditions. An analytical solution was derived which relates this depth to the water table gradient, the head difference between the ditch stage and the aquifer, the ditch width and the ratio of the vertical to horizontal hydraulic conductivity of the aquifer. The roles of recharge, aquifer heterogeneity and ditch depth in controlling the depth of the dividing surface or streamline, and thereby the effectiveness of interceptor ditches, were examined by using a numerical model. (Author's abstract) W88-08328

MONITORING OF RECHARGE WATER QUALITY UNDER WOODLAND, Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). Lab. for Soil

hygiene, Bilthover and Groundwater. For primary bibliographic entry see Field 5B. W88-08329

COMBINING PHYSICAL CONTAINMENT WITH OPTIMAL WITHDRAWAL FOR CONTAMINATED GROUNDWATER REMEDI-

Princeton Univ., NJ. Dept. of Civil Engineering. D. P. Ahlfeld, J. M. Mulvey, and G. F. Pinder. Advances in Water Resources AWREDI, Vol. 10, No. 4, p 200-204, December 1987. 4 fig, 1 tab, 13 ref.

Descriptors: *Water pollution treatment, *Containment, *Withdrawal, *Groundwater pollution, *Aquifers, Solute transport, Simulation analysis, Cost analysis, Optimization, Remedies.

Two common techniques for remediation of groundwater plumes of toxic solute are physical containment and groundwater withdrawal. A methodology is presented for determining the most efficient combination of these two techniques for remediation of a contaminated groundwater aquifer. The methods uses solute transport simulation combined with nonlinear optimization to determine the optimal withdrawal strategy while parameterizing on the containment structure size and configuration. The method has been found to give results useful for an economic interpretation. (Sand-PTT) W88-08353

TOMORROW'S WATER MANAGER, Freshwater Foundation, Navarre, MN. For primary bibliographic entry see Field 6B.

TARGETING TO PROTECT GROUNDWATER

TARGETING TO FRANCE:
QUALITY.
Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
A. M. Duda, and R. J. Johnson.
Journal of Soil and Water Conservation JSWCA3,
Vol. 42, No. 5, p 325-330, September-October

Descriptors: *Groundwater management, *Groundwater pollution, *Water quality management, *Legislation, Government finance, Drinking water, Floods, Wetlands, Tennessee Valley Authority, Clean Water Act, Economic aspects.

Protection of underground drinking water supplies Protection of underground drinking water supplies is among the nation's priority environmental issues, and groundwater protection will soon become a major force in reshaping traditional land management programs. There are a number of policy issues involved in the restructuring of programs related to activative accessive streets and when related to agriculture, energy extraction, and urban development to provide for groundwater protec-tion. Recent groundwater assessments in the sevention. Recent groundwater assessments in the sevenstate Tennessee Valley region shed some light on
the extent and complexity of these issues. Not only
were groundwater quality problems evident in
these assessments, but other serious resource management problems were found to exist in the same
areas: nonpoint-source pollution of surface waters,
loss of wetlands, threats to public safely, and economic damage related to sedimentation and increased flooding. These problems have broad implications for national policy. Institutional barriers
to establishing effective groundwater management
programs must be overcome with national legislation. Adequate funding for groundwater protection
will need to be provided by government at all

levels. Integration of cross-agency and cross-media programs will be needed to solve complex, real-world problems. An emphasis on targeting the new generation of institutional relationships to sensitive hydrogeological areas would make good fiscal and policy sense. Adoption of state groundwater classification and standards systems under Clean Water Act authorities, is an appropriate means for the complex of Act authorities is an appropriate means for this targeting of programs and for measuring progress in achieving groundwater quality goals. (Sand-

HOW TO DEAL WITH GROUNDWATER CONTAMINATION,

L. Mosher Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 5, p 333-335, September-October

Descriptors: *Groundwater pollution, *Groundwater management, *Water quality management, *Legislation, Pesticides, Fertilizers, Drinking water. Economic aspects.

Farmers are not the only target of groundwater protection laws now proliferating at the federal and state levels. Although pesticides and fertilizers are a major source of groundwater contamination, they are not the only sources, and in many parts of they are not the only sources, and in many parts of the country they are only one of the many reasons why the nation's groundwater is increasingly in trouble. What is badly missing is up-to-date infor-mation on pesticide and fertilizer usage. There are no comprehensive pesticide usage data available either at the federal or state level. This article discusses groundwater protection laws in a number of states of the U.S. and the attempts to set ground-water quality standards based on EPA drinking water standards or recommended limits. It is pointwater standards or recommended limits. It is pointed out that these standards are often vague and
arbitrary, since it is argued that it may not be valid
to extrapolate from the high doses of chemicals
used in animal experiments to the low exposures
found in the environment that might effect human
health. Current attempts at legislation at the federal level are discussed, but it is doubtful that a
comprehensive groundwater protection law will
be passed during the current congressional session. ssed during the current congressional session.

INTENSIVE CROPPING SEQUENCES TO SUSTAIN CONSERVATION TILLAGE FOR ERO-SION CONTROL,

Agricultural Research Service, Watkinsville, GA. For primary bibliographic entry see Field 2J. W88-08382

SOLID WASTE HANDBOOK: A PRACTICAL For primary bibliographic entry see Field 5E. W88-08387

LAND DISPOSAL,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5E.
W88-08388

FEDERAL REGULATORY ISSUES, Jaeckle, Fleischmann and Mugel, Washington,

DC. DC. W. L. Kovacs.

IN: The Solid Waste Handbook: A Practical Guide. John Wiley and Sons, New York. 1986. p 773-798, 100 ref.

Descriptors: *Hazardous wastes, *Federal jurisdiction, *Regulations, *Waste disposal, Waste storage, Legislation, Waste management, Resource Conservation and Recovery Act, Landfills, Linings,

The federal government as a regulator of hazardous waste from its point of generation through its transportation, treatment, storage, or disposal, is the focus of this paper. To place the role of federal regulation in perspective, this chapter reviews haz-

ardous waste management prior to the Resource Conservation and Recovery Act (RCRA), the rea-sons for federal involvement in hazardous waste soms for returnal involvement: in inazardous waste management, the legislative history of RCRA, the structure and substance of RCRA as it regulates heazardous waste, and the present status of hazardous waste regulations. Also, the organization of the Environmental Protection Agency (EPA) for the management and enforcement of its hazardous waster researched the substantial status of the substantial status management an entorcement of its nazardous waste regulations, the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (The Superfund Act), and the Superfund Act as it relates to RCRA, with recent and anticipated changes in federal regulation of hazardous waste. Among the concerns discussed are: ground-nature protections of the concerns of water protection, surface impoundments, under-ground storage tanks, waste piles and lininga, and landfills. (See also W88-08387) (Lantz-PTT)

Water Quality Control-Group 5G

EVALUATION OF OIL SPILL DISPERSANT TESTING REQUIREMENTS.

Woodward-Clyde Consultants, Walnut Creek, CA. Available from the National Technical Information Avanaore from the National Technical Information Service, Springfield, VA 22161, as PB87-232633. Price codes: A06 in paper copy, A01 in microfiche. EPA Report No. EPA/600/2-87/070, August 1987, 139 p, 9 fig. 52 tab, 19 ref, 4 append. EPA Contract 68-03-2621.

Descriptors: *Water quality control, *Oil pollu-tion, *Oil spills, *Dispersants, *Evaluation, Cost analysis, Water pollution treatment, Cleanup oper-

This research program evaluates the cost effectiveness of the procedures for testing oil spill dispersants as specified in Annex X of the National Oil and Hazardous Substances Contingency Plan. The testing procedure is described in detail in the Standard Dispersant Effectiveness and Toxicity Tests and in Annex X. These procedures were examined using No. 2 and No. 6 fuel oils and six commercial oil spill dispersants. The methods were evaluated in terms of reliability. Seven laboratory methods for testing dispersant effectiveness, and applicability. Seven laboratory methods for testing dispersant effectiveness using commercial oil spill products and No. 2 and No. 6 fuel oils were evaluated. The tests included the EPA, Mackay, Russian, French, Warren Spring, and two interfacial tension test methods (one based on the du Nouy ring principle and the other on on the du Nouy ring principle and the other on drop weight). These tests were reviewed in terms of type, scale, method of applying mixing energy, and the time required to conduct a product evalua-tion. The experimental results, compared in terms of the precision of the test data and how effective the six ponjoine dispersants were demonstrate that of the precision of the test data and how effective the six nonionic dispersants were, demonstrate that the relative effectiveness found for the dispersants varies appreciably as a function of the testing method. Reasons for the variation are discussed, and recommendations are presented on how to achieve dispersant testing data that are more representative of open-sea conditions. On the basis of these findings, recommendation for revision to the Standard. Dispersant Effectiveness Test from Annex X and the Standard Dispersant Toxicity Test were made and have been included as part of this sreport. (Author's abstract) this report. (Author's abstract) W88-08394

REMOVAL OF CADMIUM CONTAINED IN INDUSTRIAL PHOSPHORIC ACID USING THE IONIC FLOTATION TECHNIQUE, Ecole Nationale de l'Industrie Minerale, Rabat

(Morocco).

E. Jdid, P. Blazy, J. Bessiere, and R. Durand.

IN: Trace Metal Removal from Aqueous Solution.

The Proceedings of a Symposium Organized by
the Industrial Division of the Royal Society of
Chemistry as part of the Annual Chemical Congress, University of Warwick, April 3-10, 1986.

The Royal Society of Chemistry, London. Special
Publication No. 61, 1986. p 109-136, 6 fig, 11 tab,
22 ref. 22 ref.

Descriptors: *Water pollution prevention, *Wastewater treatment, *Phosphoric acid, *Cadmium, *Fertilizers, *Flotation, Heavy metals, Chemical reactions, Temperature, Calcination.

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

The problem which cadmium in phosphates poses is directly linked to the utilization of phosphate fertilizers and it may be considered specific to industrialized countries; specifically, the cadmium accumulation in the soil over the years. The only industrial cadmium elimination process is phosphate calcination at 1150 C. It has been used on the Nauru Island phosphates, and lowering cadmium content from 80 ppm to 20 ppm. It is demonstrated that an ionic flotation technique enables the elimination of the cadmium contained in the wet procthat an ionic flotation technique enables the elimination of the cadmium contained in the wet process phosphoric acid (H3POS 5,5 M; 28% P2OS). Results obtained on synthetic and industrial solutions point out the following: (1) It is possible to float cadmium with sodium diethyldithiophosphate (LET) in H3POS 5,5 M and 11,5 M media, although this operation is difficult in a diluted aqueous solution; (2) Although Cu(2+) ions precipitate but do not float with the LET collector, it is receible to float the cadmium in the presence of possible to float with the LET collector, it is possible to float the cadmium in the presence of copper which is quantitatively carried away by the cadmium precipitate: (3) If operations copper which is quantitatively carried away by the cadmium precipitate; (3) If operations occur at a temperature lower than 25 C, the presence of high concentration ferric ions (10 to the -1 M) has a moderate influence on the cadmium flotation efficiency (on the copper one, too); (4) The ferric ion reduction is necessary when the ionic flotation operations are realized at temperatures higher than 25 C; (5) In industrial phosphoric acid, generally produced at temperatures of about 60 C, the reduction involves the limitation of the collector oxidation by the ferric ions present in high concentration tion involves the limitation of the collector oxida-tion by the ferric ions present in high concentra-tions, and a reduction of the oxidizing species susceptible to react with the LET; and (6) In spite of the higher number of species present in the industrial phosphorus medium, diethyldithiophos-phate appears to be a practically selective reduc-tion medium because of its low cost. (See also. W88-08398) (Lantz-PTT) W88-08398) WES-DRADA

HEALTH AND SAFETY PROGRAM FOR GROUND-WATER INVESTIGATIONS AT 39 WASTE MANAGEMENT SITES WITHIN THE OAK RIDGE GASEOUS DIFFUSION PLANT,

OAK RIDGE GASEOUS DIFFUSION PLANT, OAK RIDGE, TENNESSEE, Geraghty and Miller, Inc., Oak Ridge, TN. P. D. Kuhlmeier, C. A. Motley, and J. A. Archer. Available from the National Technical Information Service, Springfield, VA. 22161, as DE87-011801. Price codes: A04 in paper copy, A01 in microfiche. Report No. K/SUB-85-22224/5, June 1987. 61 p, 5 fig, 3 tab.

Descriptors: *Groundwater atudies, *Monitoring wells, *Groundwater quality, *Oak Ridge, *Safety, Tennessee, Personnel, Manpower, Education, Manuals, Public health.

A Health and Safety Plan has been prepared to provide for the safety of the personnel responsible for the installation of the groundwater monitor for the installation of the groundwater monitor well network at the Resource Conservation and Recovery Act and CERCLA sites at the K-25 Plant, Oak Ridge, Tennessee. The plan has been assembled based upon requirements described in the 'Standard Operating Safety Guides' written by the Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, EPA. Guidelines provided in this EPA publication have been supplemented by knowledge gained from previous drilling experience at the site. During the geohydrologic characterization of 14 waste disposal sites in the fall and winter of 1985 and for monitor well installations in 1986/1987, health/safety procedures were supervised. During drilling and well construction each location was monitored for airborne ionizable pollutants, combustable gases and radioactivity. The field monitoring indicated workers were not exposed to concentrations of gases above were not exposed to concentrations of gases above the permissible exposure limits, nor radiation above the permissible exposure limits, nor radiation above the permissible the stablished by the U.S. Department of Energy. (Lantz-PTT) W88-08418

NATIONAL SURFACE WATER SURVEY. WESTERN LAKE SURVEY (PHASE I - SYN-OPTIC CHEMISTRY): ANALYTICAL METH-ODS MANUAL, Lockheed Engineering and Management Services

Co., Inc., Las Vegas, NV. For primary bibliographic entry see Field 5A. W88-08423

SAFE DRINKING WATER ACT COST IM-PACTS ON SELECTED WATER SYSTEMS, CWC-HDR, Inc., Santa Ana, CA. B. E. Burris, and R. C. Gumerman.

Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-227260. Price codes: A14 in paper copy, A01 in microfiche. EPA Report No. EPA/600/2-87/038, August 1987, 326 p. 134 fig, 88 tab. EPA Contract No. 68-03-3216

Descriptors: *Costs, *Drinking water, *Safe Drinking Water Act, *Water treatment facilities, Legislation, Water quality, Coliforms, Bacteria, Turbidity, Trihalomethanes, Trichloroethylene, Water treatment, Flocculation, Sedimentation, Filtration, Chlorination, Ozonation, Economic aspects, Organic compounds, Operating costs, Capital costs, Maintenance costs.

Detailed site visits were made to eight U.S. water utilities to assess the capital and operating and maintenance (O and M) costs of meeting the requirements of the Safe Drinking Water Act (SDWA). New treatment facilities were construct-(SLIWA). New treatment facilities were constructed at each of the utilities to correct water quality problems which are current issues under the SDWA. The drinking water problems addressed include coliform bacteria, turbidity, trihalomethanes (THM's), Giardia lamblia, and trichloroethylene (TCE). New treatment facilities constructed included conventional treatment using flocculation, sedimentation, filtration, and chlorination for coliform bacteria, turbidity, and Giardia removal. tion, sedimentation, filtration, and chlorination for colliform bacteria, turbidity, and Giardia removal. Preozonation was installed at one utility for reduction of THMs. Airstripping facilities were constructed at three of the utilities primarily for removal of TCE from groundwater. In addition to documenting the costs of meeting the SDWA, the individual reports prepared for each utility contain 10 years worth of data on many water system activities. These include capital and O and M costs for the categories of acquisition, treatment, and distribution of water, and support services. Other information compiled includes detailed water (quantity data and specific O and M costs. Capital and O and M cost ranges are presented for conventional water treatment facilities and for airstripping facilities for TCE removal. (Author's abstract)

W88-08428

REMEDIATION OF A DIOXIN-CONTAMI-NATED SURFACE IMPOUNDMENT, NATED SURFACE IMPOUNDMENT, Syntex Agribusiness, Inc., Springfield, MO. R. K. Forrester, L. Marple, and C. P. Carson. IN: Solving Hazardous Waste Problems: Learning from Dioxins. American Chemical Society, Wash-ington, DC. 1987. p 278-285.

Descriptors: "Waste disposal, "Reservoirs, "Dioxin, "Contamination, "Chemical wastes, "Cleanup operations, "Cleanup, "Organic solvents, "Excavation, "Chemical sludge, Remediate, Soil contamination, Dewatering, Fate of pollutants.

The complete remedial plan for cleanup of an unlined surface impoundment containing dioxin and solvent contaminated waste contains a brief and solvent contaminated waste contains a brief history, preliminary sampling, pertinent scientific studies, development of a plan, site preparation, excavation of dioxin and solvent contaminated sludges and soils, on-site storage of wastes and ultimate disposal plans. Special emphasis is given to techniques for removal of dioxin from wastewater streams and a method of dewatering organic chemical sludge. The design and permitting of an on-site dioxin storage facility is described. Environmental and personal monitoring, scribed. Environmental and personal monitoring, safety, special protective equipment, decontamination procedures and other general considerations are briefly discussed. (See also W88-08431) (Author's abstract) W88-08439

REMOVAL OF 2,3,7,8-TETRACHLORODICH LORODIBENZO-P-DIOXIN FROM WASTI

WATER AND WELL WATER: COAGULATION AND FLOCCULATION WITH ALUMINUM SALTS

Syntex (USA), Inc., Palo Alto, CA. For primary bibliographic entry see Field 5E. W88-08440

EROSION AND SEDIMENT POLLUTION CONTROL, For primary bibliographic entry see Field 2J. W88-08505

HAZARDOUS WASTE LAW AND PRACTICE, Vanderbilt Univ., Nashville, TN. School of Law. J. M. Stensvaag. Wiley Law Publications. John Wiley and Sons, New York. 1986. 512 p.

Descriptors: *Hazardous wastes, *Legislation, *Water pollution prevention, Legal aspects, Regulations, Waste disposal.

Subtitle C of the Resource Conservation and Recovery Act (RCRA) is the only federal statutory program regulating the category of materials that has been formally designated as 'hazardous waste.' The environmental law practitioner must be familiar with a wide variety of other materials that the lay person understandably associates with the hazardous waste label, such as 'hazardous substances,' xoic water pollutants,' 'hazardous air pollutants,' hazardous materials,' so-called 'toxic substances,' and 'regulated substances.' However, these substances are regulated under federal statutory programs other than RCRA Subtitle C. Unless these materials also happen to be hazardous wastes, they grams other than RCAA Subuttle C. Unless these
materials also happen to be hazardous wastes, they
are not within the direct scope of this work. The
statute directs the Environmental Protection
Agency (EPA) to identify the universe of materials
that will be subject to Subtitle C regulation: hazardous wastes. The statute also directs the EPA to establish standards governing the conduct of three categories of actors who handle hazardous wastes: establish standards governing the conduct of three categories of actors who handle hazardous wastes: (1) generators; (2) transporters; and (3) owners and operators of treatment, storage, or disposal facilities. Without question, the most difficult task facing anyone who seeks to learn or convey the law of hazardous waste is the problem of organization. It is suggested that almost all Subitile C problems may be solved by addressing three points in the following order: (1) Whether the material under consideration is a hazardous waste; (2) If it is, whether the person handling the material falls within one or more of the categories of actors subject to Subtile C regulation; and (3) What obligations the regulated actor must comply with in handling the hazardous waste. This book is organized in accordance with this analytical approach. Volume 1 is devoted to answering a portion of the first point; the remainder of issue one is addressed in the first two chapters of Volume 2. Subsequent volumes will address the second and third points. (Lantz-PTT) W88-08506 WRR-DRSD6

F-AREA SEEPAGE BASINS,

Savannah River Lab., Aiken, SC. Environmental Sciences Div For primary bibliographic entry see Field 5B. W88-08508

SAVANNAH RIVER PLANT ENVIRONMEN-TAL REPORT: ANNUAL REPORT FOR 1986, Radiological Assessments Corp., Neeses, nary bibliographic entry see Field 5B. W88-08509

DRASTIC: A STANDARDIZED SYSTEM FOR EVALUATING GROUND WATER POLLUTION POTENTIAL USING HYDROGEOLOGIC SET-National Water Well Association, Worthington,

For primary bibliographic entry see Field 7A. W88-08510

GRAYS HARBOR ESTUARY MANAGEMENT

PLAN.
Available from the National Technical Information
Service, Springfield, VA. 22161, as PB87-229506.
Price codes: A06 in paper copy, A01 in microfiche,
january 1986. 132 p, 11 append.

Descriptors: *Grays Harbor, *Water quality management, *Washington, *Estuaries, *Management planning, Conflicting use, Economic aspects, Social aspects, Regulations, Legislation, Interagency cooperation.

Grays Harbor is one of two major estuaries on the Washington coast and is the only coastal estuary in the state with an authorized deep water navigation channel and major port. The Grays Harbor estuary provides an important transportation link to local, national and international markets and serves as a provides an important transportation link to local, national and international markets and serves as a focal point for the regional economy. In addition, the estuary is a nursery ground and passage way for a vast array of living resources and an important link in the migratory patterns of many fish and wildlife species. In response to increasing conflicts over use the resource of the estuary, the Grays Harbor Regional Planning Commission formed an Estuary Planning Task Force in late 1975. In September 1976, the Task Force in the 1975. In September 1976, the Task Force in the 1975. In September 1976, the Task Force in the 1975. In September 1976, the Task Force in the 1975. In September 1978, the Task Force in the 1975. In September 1978, the Task Force in the preparation of the plan. The Grays Harbor Estuary Management Plan. A consultant was retained to assist the Task Force in the preparation of the plan. The Grays Harbor Estuary Management Plan does not eliminate or modify any of the laws, regulations, or policies which govern the actions and decisions of local, state, or federal agencies. The plan improves the interpretation and implementation of those laws and regulations. The plan attempts to meld the various authorities and concerns into unified estuary-wide guidelines for both protection and development of the acceptance of the accep concerns into unified estuary-wide guidelines for both protection and development of the area's both protection and development of the area's economic and natural resources. Since the plan has been prepared by participating local, state and federal agencies with recognition of legal and policy constraints on each, it helps avoid piecemeal decision making in the permit processes. Activities that are not allowed by the Plan can expect to be denied by participating agencies. (Lantz-PTT) W88-08512

NEW HAMPSHIRE COASTAL PROGRAM OCEAN AND HARBOR SEGMENT AND FINAL ENVIRONMENTAL IMPACT STATE-MENT.

National Oceanic and Atmospheric Administra-tion, Washington, DC. Office of Coastal Zone Mana

Management. Available from the National Technical Information Service, Springfield, VA. 22161, as PB87-228219. Price codes: Al 0 in paper copy, A01 in microfiche. April 1982. 243 p, 8 fig, 5 append.

Descriptors: *New Hampshire, *Coastal zone management, *Land use, *Water use, *Harbors, *Management planning, Legislation, Decision making, Economic aspects, Coastal waters, Environmental

The State of New Hampshire has submitted the Ocean and Harbor Segment of its Coastal Program to the Office of Coastal Zone Management for Ocean and Harbor Segment of its Coastal Program to the Office of Coastal Zone Management for approval. Approval would allow program administrative grants to be awarded to the state, and would require that federal actions be consistent with the program. This document includes a copy of the program (Part II), which is a comprehensive management program for coastal land and water use activities. It consists of numerous policies on diverse management issues which are administered under existing state laws and is the culmination of several years of program development. The effect of these policies is to condition, restrict or prohibit various uses in parts of the coastal zone while encouraging development and other uses in other parts. The program will improve decision making processes for determining appropriate considerations and increase public awareness of coastal resources. It may result in some short-term economic impacts on coastal users but will lead to increased long-term protection of the state's coastal resources and

improve the responsiveness of state programs. Approval and implementation of the program will enhance governance of the state's coastal land and enhance governance of the state's coastal land and water areas and uses according to the coastal policies and standards contained in existing statutes, authorities and rules. Federal alternatives to program approval include delaying or denying approval, if certain requirements of the Coastal Zone Management Act have not been met. The state could modify parts of the program or withdraw their application for federal approval if either of the above federal alternatives result from circulation of this document. (Author's abstract) W88-08513

HAZARDOUS WASTE REGULATION HAND-BOOK: A PRACTICAL GUIDE TO RCRA AND

Wald, Harkrader and Ross, Washington, DC. S. M. Briggum, G. S. Goldman, D. H. Squire, and D. B. Weinberg.

Executive Enterprises Publications Co., Inc., New York. 1985. 507 p, 16 append.

Descriptors: *Regulations, *Hazardous wastes, *Resource Conservation and Recovery Act, *Su-perfund, Handbooks, Legislation, Legal aspects, Waste management, Waste disposal.

The obligations imposed by the two principal federal statutes, the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) have been expanded in recent years. The objective of this handbook is to provide a practical, usable guide the principal obligations imposed by RCRA and Superfund are identified and described. Included are compliance checklists, and directions to the regulatory provisions, interpretations, or decisions that deal with specific concerns. Part 1 provides a very broad overview of the two programs. Part 2 traditional provides a very broad overview of the two programs. Part 1 provides a very broad overview of the two programs. Part 2 describes substances and waste practices subject to regulation under RCRA and Superfund. Parts 3-7 explain the responsibilities of each participant in the waste management process (generators, transporters, and treaters, storers, and disposers) and discusses the relationships between the RCRA and Superfund requirements that affect each of them. Part 8 discusses enforcement under RCRA and Superfund as well as related, non-statutory 'common law' theories of liability for waste management activities being applied by the courts. Following the text are a series of appendices designed to provide guidance on areas of particular concern and to explain more fully key regulatory provisions and obligations. (Lantz-PTT) W88-08515 W88-08515

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION I.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08516

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION II.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08517

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION III.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08518

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION IV.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08519

Water Quality Control—Group 5G

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION V.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88_08520

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION VI.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08521

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION VII.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08522

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION VIII.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08523

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION IX. National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08524

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION X. National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08525

CATALYZED PHOTODEGRADATION OF THE HERBICIDES MOLINATE AND THIOBEN-

California Univ., Davis. Dept. of Environmental Toxicology.

R. B. Draper, and D. G. Crosby.

IN: Photochemistry of Environmental Aquatic Systems. ACS Symposium Series No. 327. American Chemical Society, Washington, D.C. 1987. p 240-247, 5 fig. 1 tab, 19 ref.

Descriptors: *Water pollution prevention, *Degradation, *Photochemistry, *Photoactivation, *Öxidation, *Biodegradation, *Herbicides, Irradiation, Chemical properties, Chemical degradation, Oxides, Agriculture, Wastewater treatemnt, Farm

A survey of oxidizing agents capable of supplementing the natural oxidants of field water showed menting the natural axistants of near water shower that the rice herbicides molinate (I) and thiobencarb (VIII) were degraded rapidly in sunlight irradiated suspensions of TiO2 and ZnO. ZnO served both as a semiconductor photooxidant and as the Zn(II) fertilizer normally applied for plant nutrition. In a flooded rice field, isolated basins nutrition. In a Hooded rice field, isolated basins were treated with Ordram 10G (mollinate); after 3 days, an aqueous ZnO suspension, stable in field water at pH 8 to 9, was applied. The resulting immediate decrease in molinate half-life from 60 h to 1.5 h indicates that applying ZnO before releasing agricultural wastewater may reprovide an economic provide an economic provide and eco ing agricultural wastewater may provide an economical means of intentionally degrading persistent chemical residues. (See also W88-08526) (Author's abstract) W88_08538

IS FEDERAL FUNDING THE ANSWER TO WATER SUPPLY NEEDS, Smith and Loveless, Inc., Lenexa, KS.

R. L. Rebori. Water Engineering and Management WENMD2, Vol. 135, No. 3, p 14-16, March 1988.

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G-Water Quality Control

Descriptors: *Safe Drinking Water Act, *Drinking water, *Water law, *Water supply, *Water quality, *Economic aspects, Groundwater protection, Public Policy, Pollution, Environmental Protection Agency, Federal regulation.

The Safe Water Drinking Act Amendments of 1986 set forth strict directives for issuing primary drinking water standards and establishing new inidrinking water standards and establishing new initiatives for protecting underground sources of water. To deal with the costs incurred in complying with the new regulations Congress is drafting The Water Supply Assistance Act (United States Senate Committee on Environment and Public Works, September 25, 1987) which states its specific purposes as (1) Establish a trust fund from which capitalization grants will be made to states to finance the construction of water system improvement, and (2) Establish a program of research and development for innovative water systems technologies. The proposed sources of funds for the Act are a 3% tax on plumbing supplies, a national uniform water fee of 4 to 8 mills per thousands of gallons of water, and General Treasury revenues. The author states that while the concept of providing monetary assistance to individual water sapply districts is commendable and perhaps needed, the ing monetary assistance to individual water supply districts is commendable and perhaps needed, the method as suggested by the proposed Water Supply Assistance Act is not the answer. The author feels that the approach is too costly and an expansion of the federal government. All participants in the drinking water industry are urged to carefully consider the implications of this program. -PTT)

REDUCTION IN ORGANIC EFFLUENT STATIC ACUTE TOXICITY TO FATHEAD MINNOWS BY VARIOUS AERATION TECH-

MINNOWS BY VARIOUS AERATION TECHNIQUES, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Biology. S. E. Belanger, J. L. Farris, and D. S. Cherry. Environmental Pollution EPEBD7, Vol. 50, No. 3, p 189-210, 1988. 6 fig. 3 tab, 28 ref.

Descriptors: *Water pollution control, *Aeration, *Bioassay, *Fathead minnows, *Fish, *Toxicity, *Pollution effects, Mortality, Dissolved oxygen, Temperature effects, Seasonal variation, Phenolic-based effluents, Water pollution, Pollutants.

This study compared the results of no aeration, intermittent aeration, and constant aeration strategies in determining the static acute (48 h) toxicity of phenolic based effluents to fathead minnows of phenolic based efficients to fatheau minnows (Pimephales promelas). Toxicity was greatest in no aeration tests followed by intermittent aeration and constant aeration. Two factors were considered responsible for the observed pattern of toxicity. First, in side-by-side tests of no versus intermittent aeration and intermittent versus constant aeration, aeration and intermittent versus constant aeration, toxicity reductions were directly attributed to maintenance of dissolved oxygen above 5.0 mg per 1 in aerated containers. Secondly, toxicity was reduced when treatment system temperatures were warmest, probably due to increased microbial activity and volatilisation during late spring to early autumn (temperatures > 16 C). Effluent was slightly more toxic on-site than off-site, presumably due to destradation of nhenolic compounds during the programment of the programment due to degradation of phenolic compounds during transportation and set-up at the off-site laboratory (approximately 4.5 h) Gill tissue ultrastructure and (approximately 4.5 h) Gill tissue ultrastructure and histopathology were used to determine the effect of effluent-induced damage and the recovery of minnows to short (6 h) effluent exposures. After a 48 h exposure to the approximate LC sub 50 concentration, gill tissue lamellae were characteristically desquamated with epithelium lifting from the basement membrane. Gill tissue was similarly damaged after a 6 h exposure to 100% effluent and had recovered to pre-exposure conditions after 42 h in clean water. Aeration strategies in these studies demonstrated potential airstripping of volatile compounds, although stress to test organisms from low dissolved oxygen was relieved. (Author's abstract) stract) W88-08564

APPLICATION OF TW WATER QUALITY MODEL, TWO-DIMENSIONAL

Environmental Protection Agency, Athens, GA.

Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 317-336, April 1988. 7 fig, 3 tab,

Descriptors: *Water quality, *Reservoirs, *Lakes, *DeGray Lake, *Path of pollutants, *Dissolved oxygen, *Mathematical models, *Model studies, Hydrodynamics, Arkansas, Limnology.

A two-dimensional, laterally averaged, finite-dif-ference hydrodynamic and transport water quality model was applied to DeGray Lake, Arkansas, a reservoir extensively studied by the U.S. Army Corps of Engineers. The reservoir was known to exhibit strong longitudinal and vertical gradients in water quality, while lateral variations were gener-ally small. DeGray Lake exhibited dissolved oxygen declines in the metalimnion of the main pool and hypolimnion of headwater regions during summer and fall months. Field data from two separate vears were used to calibrate and verify the separate years were used to calibrate and verify the model. Spatial and temporal variations in dissolved oxygen concentrations and other water quality variables were successfully predicted throughout the stratification cycles. (Author's abstract) W88-08572

ASSESSMENT OF PHOSPHORUS SOURCES TO BLACK LAKE, NEW YORK, Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5B. W88-08573.

BIOLOGICAL TREATABILITY OF IN SITU COAL GASIFICATION WASTEWATER,

Arizona Div., Tucson. Dept. of Civil Engineering and Engineering Mechanics. For primary bibliographic entry see Field 5D. W88-08576

ECONOMIC ANALYSIS OF AGRICULTURAL NONPOINT POLLUTION CONTROL ALTER-NATIVES.

Illinois Univ. at Urbana-Champaign. Dept. of Ag-

ricultural Economics.
P. Setia, and R. Magleby.
Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 6, p 427-430, November-December 1987. 5 tab, 11 ref.

Descriptors: *Agricultural runoff, *Rural Clean Water Program, *Water pollution control, *Conservation, *Nonpoint pollution sources, *Cost-benefit analysis, *Watershed management, *Water quality control, Food crops, Economic aspects, Model studies, Hydrology, Agriculture, Economic valuation.

Hydrologic and economic models were used to analyze the costs and effectiveness of implementing best management practices under the Rural Clean Water Program in a southwestern Illinois watershed. Economic benefits and costs to water users and participating farmers were also evaluated. Results show that the cost-effectiveness of the implemented practices in achieving water quality. implemented practices in achieving water quality could have been improved by promoting the adoption of conservation tillage and selected crop rotations on all cropland in the watershed. (Author's abstract) W88-08622

MOTION OF COASTAL CONFINED GROUND-WATER IN THE PRESENCE OF VARIOUS PATTERNS OF PUMPING: II. NUMERICAL ANALYSIS BY THE STEADY STATE DISPER-SION MODEL, (IN JAPANESE), Ehime Univ., Matsuyama (Japan). Dept. of Ocean

Engineering.
For primary bibliographic entry see Field 2F. WRR ORASO

SOIL LIMING AS A MEASURE TO MITIGATE ACID RUNOFF, Lund Inst. of Tech. (Sweden). Dept. of Chemical

P. Warfvinge, and H. Sverdrup.
Water Resources Research WRERAO, Vol. 24, No. 5, p 701-712, May 1988. 11 fig, 2 tab, 46 ref.

Descriptors: "Soil treatment, "Liming, "Acid rain, "Acid streams, "Acidic soils, "Mathematical models, Watersheds, Watershed management, Wetlands, Sweden, Soil chemistry, Model testing, Sensitivity analysis, Leaching, Chemical reactions, Water pollution control.

Watershed liming is one method to decrease the acidity of surface waters. To gain an understanding of the mechanisms involved in terrestrial liming and to develop a tool for planning and evaluation, a mathematical model was developed. The model includes key chemical processes such as limestone dissolution, cation-exchange reactions, and leaching and accumulation of dissolved species. The ability of the model to describe the short and long-term improvement in stream water quality following wetland liming was demonstrated by comparing the model calculations with data from two Swedish full-scale liming experiments. The influence of temporal hydrological and chemical variations on model output was assessed. The sensitivity of the system response to liming was analyzed with respect to three design parameters: the amount and the fineness of the liming material, and the fraction of the watershed that is treated. The simulations illustrate the importance of careful soil simulations illustrate the importance of careful soil and hydrological characterization of treated watersheds to ensure that the limestone dose and the treated area are sufficient to ensure a satisfactory increase in stream pH and resistance to reacidifica-tion. (Author's abstract) W88-08663

DEVELOPMENT OF A WATER QUALITY PLANNING MODEL USING UTM SQUARE-GRID SYSTEM,

Institut National de la Recherche Scientifique. Sainte-Foy (Quebec).

D. Couillard.

Journal of Environmental Management JEVMAW, Vol. 26, No. 2, p 95-101, March 1988. 2 fig, 3 tab, 15 ref.

Descriptors: *Watersheds, *Water quality, *Model studies, *Water quality management, *Management planning, *Data collections, *Eutrophication, Spatial distribution, Drainage systems, Water pollution sources, Equations, Canada.

The structure of a watershed data bank oriented towards eutrophication problems is described. A spatial evaluation is carried out using the Universal Transverse Mercator (UTM) square-grid system, the basic drainage unit being a sub-basin of this 10 sq km. The Canadian physiographical data bank provides the drainage pattern and the vegetation coverage. The Canadian Bureau of Statistics provides data about most nutrient-exporting land uses by municipal areas, and information about industry is given by the Scott's Industrial Directory. Point-source polluters are linked directly to their outfall sub-basin unit, and non-point-source polluters are sub-basin unit, and non-point-source polluters are distributed to the square grid in proportion to the areas of the municipalities. (Author's abstract)

ACCELERATING RECOVERY OF THE MER-CURY-CONTAMINATED WABIGOON/ENG-

LISH RIVER SYSTEM, Ontario Ministry of the Environment, Thunder Bay (Ontario).

J. W. Parks, and A. L. Hamilton Hydrobiologia HYDRB8, Vol. 149, p 159-188, June 1987. 13 fig, 4 tab, 65 ref.

Descriptors: "Mercury, "Wabigoon River, "Mercury, "English River, "Lake restoration, "Water quality management, "Rehabilitation, "Water pollution treatment, "Water quality, "Heavy metals, "Path of pollutants, "Fate of pollutants, Sedimentwater interfaces, Sedimentation, Bioaccumulation, Contamination, Sediments, Biodegradation, Ecological effects, Economic aspects, Clay.

Techniques Of Planning—Group 6A

Mercury levels in sportfish of the Wabigoon-English River system are elevated as a result of inorganic Hg from a chlor-alkali plant. For example, Hg in adult Northern Pike in Clay Lake routinely exceeded 3 micrograms/g (ppm). Field studies in 1978-81 suggest that partitioning of inorganic and methyl mercury (MeHg) between surface sediment, water, and suspended particles occurs within days. Temperature affects both Hg and MeHg levels in water; concentrations fluctuated seasonally by an order of magnitude at some sites. Hg in contaminated surface sediments is almost certainly the primary source of the mercury now entering the water and biota in this contaminated water-course. Mercury levels in biota decline less dramatically with distance downstream than mercury concentrations in sediments. Natural erosion, resuspension and sedimentation processes have helped spension and sedimentation processes have helped to reduce the amount of mercury in the active layer at the sediment/water interface and most effective means of accelerating the recovery of the system will probably involve measures to accelerate these natural processes. Enclosure experiments, regional surveys and geochemical studies all provide evidence that the biological uptake of upstream anthropogenic Hg loadings at any given site would likely be reduced dramatically by the continuous addition of very modest quantities of pristine clay sediment. The quantities contemplated, when resuspended, would result in suspended soilds concentrations on the order of 15-25 ppm, a value higher than for most shield waters but well within the range of many other productive water-courses in North America. The ability to mitigate local sources and ameliorate the adverse biological effects of anthropogenic loadings from upstream sources by resuspension of clean clay sediments permits 'targeting' of sites for restoration and opens in wide array of ameliorative options. The authors believe that some of these options would be more effective and less costly than other restoration procedures commonly considered such as dredging and on land disposal of contaminated sediment. (Author's abstract) layer at the sediment/water interface and most effective means of accelerating the recovery of the

PROTOCOL FOR THE SELECTION OF PROCESS-ORIENTED REMEDIAL OPTIONS TO CONTROL IN SITU SEDIMENT CONTAMI-

International Joint Commission-United States and Canada, Windsor (Ontario).

Canada, Whoso (Charle). R. L. Thomas. Hydrobiologia HYDRB8, Vol. 149, p 247-258, June 1987. 1 fig, 2 tab, 10 ref.

Descriptors: *Adsorption, *Sediments, *Path of pollutants, *Toxicity, *Water quality control, *Rehabilitation, *Management planning, *Pollutants, *Water pollution sources, Ecological effects, Aquatic habitats, Land disposal, Dredging.

The role of sediment in the adsorption and desorption of toxic elements and compounds is well known. By these processes, elements are moved from their points of origin to a final sink. Areas of intense human activity are characterized by the production of a large array of toxic materials, many of which may be found in the sediments of a variety of areas in the world. It has been shown, even when sources of elements and compounds have been eliminated, that the recovery rate of such areas is non-existent or slow due to the direct effects of the polluted sediment on the associated ecosystem. This paper briefly discusses the problem and discusses a number of remedial options and their selection. The options include dredging, leaving in place or a series of inactivation methods to be applied in situ. These in situ methods include covering, plowing and acceleration of the rate of sediment accumulation. Following any remedial action, monitoring must continue to ensure that the system is recovering in a manner that achieves the specified objectives of the remedial plan. (Author's abstract) The role of sediment in the adsorption and desorp-

REGION III ENVIRONMENTAL PROTEC-TION AGENCY GROUND WATER PROTEC-

Environmental Protection Agency, Philadelphia,

PA. Region III. S. Kerzner.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 21, No. 3, p 7-9, May-June

Descriptors: *Water pollution control, *Ground-water management, *Groundwater pollution, En-vironmental protection, Federal jurisdiction, State

In the summer of 1984, the U.S. Environmental Protection Agency (EPA) issued its strategy to protect groundwater. The aim of the Ground Water Strategy is to build up the institutional capability in the states and the EPA to deal with groundwater problems on a comprehensive and coordinated basis. It is felt that the Strategy provides creater consistency and coherence among coordinated basis. It is ten that the Strategy pro-vides greater consistency and coherence among EPA programs aimed at protecting groundwater and initiates new steps to deal with major forms of and initiates new steps to deal with major forms of groundwater contamination that are presently not fully controlled. The basic elements of the Strategy are to do the following: (1) strengthen state groundwater programs, (2) cope with currently unaddressed groundwater problems, (3) create a policy framework for guiding EPA programs, and (4) strengthen internal groundwater organization. These 4 points are discussed in more detail, and the importance of this program in protecting ground-water in the U.S. is pointed out. (Brock-PTT)

NITRATE PROBLEM IN GROUNDWATER: WHAT CAN BE DONE, Wright (R.E.) Associates, Middletown, P.A. For primary bibliographic entry see Field 5B. W88-08902

PENNSYLVANIA'S GROUND WATER QUAL-ITY PROTECTION PROGRAM, Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management. H. Miller

Water Pollution Control Association of Pennsylva-na Magazine, Vol. 21, No. 3, p 24-26, May-June

Descriptors: *Groundwater management, *Water quality control, Pennsylvania, Public policy, Environmental policy, Regulations.

Due to the importance of groundwater in supply-Due to the importance of groundwater in supplying the water needs of Pennsylvania, it is necessary for the quality of this resource to be protected. The Pennsylvania Department of Environmental Resources (DER) has been actively involved in groundwater protection since the early 1960's. Despite this, there are no legally specified groundwater quality standards. Efforts are underway to respite tins, there are no legany spectities groundwater quality standards. Efforts are underway to resolve this matter by finalizing a groundwater quality protection strategy and developing proposed groundwater quality protection regulations. To improve the effectiveness in protecting the state's groundwater resource, work is also progressing on a comprehensive groundwater monitoring and data assessment program. As a second means of strengthening the Department's overall groundwater assessment capabilities, efforts are underway to improve quality data management. This will improve the ability to detect emerging groundwater problems in area which are heavily reliant on groundwater, evaluate the impacts of unmonitored sources, and assess the overall effectiveness of the Department's regulatory efforts. (Brock-PTT) W88-08903

GROUNDWATER MODELING: A PRACTICAL APPLICATION FOR GROUNDWATER MAN-

Buchart-Horn, Inc., York, PA.

T. E. Saylor.

Water Pollution Control Association of Pennsylvania Magazine, Vol. 21, No. 3, p 28-31, May-June 1988. 4 fig.

Descriptors: *Groundwater management, *Groundwater pollution, *Computer models, Model studies, Potable water, Planning, Water

Groundwater serves as the source of potable water for more than 30% of the U.S., yet there is increasing evidence that more and more groundwater is becoming contaminated and polluted. Unlike many mineral resources, groundwater is a renewable resource if managed properly. Unfortunately, groundwater systems are poorly understood and sometimes poorly managed by some municipal and private water purveyors. Therefore, it is important that effective methods of managing groundwater supply are developed. One way that could be very effective is to develop a computerized model of the groundwater system. Once such a model is developed. groundwater system. Once such a model is developed, changes in stresses can be imposed on the model and their effects can be simulated. Thus, it is model and their effects can be simulated. Thus, it is a tool to plan and consequently better manage groundwater supplies. A model called the Modular Three Dimensional Finite Flow Model allows the manager to understand his groundwater supply in the context that it is a part of a dynamic, everchanging system and that it can be used efficiently and properly to assure a safe and reliable water supply. (Brock-PTT)
W88-08904

6. WATER RESOURCES **PLANNING**

6A. Techniques Of Planning

DERIVING THE NONLINEAR RISK-BENEFIT ALGORITHM FOR RESERVOIRS.

Mahidol Univ., Bangkok (Thailand). Dept. of Environmental and Resource Studies.

T. Uan-On, and O. J. Helweg. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 261-268, April 1988. 4 fig, 1 tab, 32 ref.

Descriptors: *Nonlinear programming, *Design standards, *Algorithms, *Risks, *Reservoirs, Model studies, Computer programs, Water resources development, Optimization, Cost-benefit analysis, Hyroelectric power.

The Nonlinear Risk-Benefit (NRB) Algorithm in-The Nominear Nas-Bellett (NAS) collectives in a multiple-objective optimization problem. The NRB Algo-rithm is derived by extending the Surrogate Worth Trade-Off method to quadratic programming. This Trade-Off method to quadratic programming. This category of problem is common in water resources planning and design, especially multi-purpose reservoir systems. Consequently, an example is given using the algorithm for optimally operating a multipurpose reservoir. The NRB algorithm not only incorporates risk into the objective function, clearly displaying what it will 'cost' the decision-maker to change reliabilities, but it more accurately reflects the heagefit of a routinear objective sure as flects the benefits of a nonlinear objective such as hydropower by using a quadratic objective func-tion to approximate the actual benefit curve. (Alex-ander-PTT) W88-08031

IRRIGATION WATER DELIVERY SYSTEM OPERATION VIA AGGREGATE STATE DYNAMIC PROGRAMMING,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 3F. W88-08051

SEPARABLE LINEAR ALGORITHM FOR HYDROPOWER OPTIMIZATION,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering. For primary bibliographic entry see Field 8C. W88-08052

GROUNDWATER RECHARGE PLANNING USING RESOLVENT DISCRETE KERNELS,

Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 2F.

W88-08061

Field 6-WATER RESOURCES PLANNING

Group 6A—Techniques Of Planning

SATELLITE REMOTE SENSING FOR WATER RESOURCES MANAGEMENT: SOME ENGINEERING AND ECONOMIC ASPECTS, Ruhr Univ., Bochum (Germany, F.R.). For primary bibliographic entry see Field 7B. W88-08477

WATER RESOURCES: PLANNING AND MAN-For primary bibliographic entry see Field 6B. W88-08543

SINGLE DECISION-MAKER APPROACH TO IRRIGATION RESERVOIR AND FARM MANAGEMENT DECISION MAKING,

New South Wales Univ., Kensington (Australia). School of Economics.

N. J. Dudley. Water Resources Research WRERAO, Vol. 24, No. 5, p 633-640, May 1988. 5 fig, 1 tab, 20 ref.

Descriptors: *Decision making, *Irrigation programs, *Resource allocation, *Optimum development plans, *Farm_management, *Model studies, ater models, Reservoir operation, Irrigation, Irrigation, Irrigation, Riparian waters, Valleys, Management planning, Riparian waters, Economic efficiency.

A model for optimizing short-, intermediate-, and long-run irrigation decisions for surface water reservoirs was developed for a river valley irrigation system controlled by one decision maker. The modeled valley is characterized by highly variable reservoir; inflows, and cron growing conditions. modeled valley is characterized by highly variable reservoir inflows and crop growing conditions, and irrigable land supplies which are plentiful relative to available water. It advances similar work of the early 1970s pertaining to a corn monoculture by using a complex soil water-plant growth simulation model for cotton developed by crop scientists over a number of years, and by employing an extra model to simulate the effects of using optimal decisions derived by dynamic programming. The decisions derived by dynamic programming. The results indicate a potential for disagreement about resurs indicate a potential for disagreement about reservoir management strategies and the level of irrigation development between irrigators, other members of the local economy, and national econ-omy policy makers. The assumption of one deci-sion maker internalizes the derivation and communication of supply and demand probabilities, giving the results a level of economic efficiency which makes them a standard against which to judge the results of decentralized models. (Author's abstract)

VOLUME SHARING OF RESERVOIR WATER, New South Wales Univ., Kensington (Australia). School of Econon

N. J. Dudley. Water Resources Research WRERAO, Vol. 24, No. 5, p 641-648, May 1988. 3 fig, 2 tab, 10 ref.

Descriptors: *Volume sharing, *Reservoir operation, *Resource allocation, *Reservoir releases, *Model studies, *Decision making, Irrigation programs, Computer models, Priorities, Optimization, Computers, Farm management, Management planning. Economic efficiency.

Previous models optimize short-, intermediate, and long-run irrigation decision making in a simplified river valley system characterized by highly variable water supplies and demands for a single decision maker controlling both reservoir releases and farm water use. A major problem in relaxing the assumption of one decision maker is communicating the stochastic nature of supplies and de-mands between reservoir and farm managers. An optimizing model was used to develop release rules for reservoir management when all users share for reservoir management when all users share equally in releases, and computer simulation was used to generate an historical time sequence of announced releases. These announced releases become a state variable in a farm management model which optimizes farm area-to-irrigate decisions through time. Such demand modeling envisaged the use of growing area climatic data by the reservoir authority to gauge water demand and the transfer of water supply data from the reservoir for managers, via computer data files. Alternative farm managers, via computer data files. Alternative model forms, including allocating water on a prior-

ity basis, are discussed briefly. The results show lower mean aggregate farm income and lower variance of aggregate farm income than in the single decision-maker case. This short-run economsingle decision-make class. This short-the contonic efficiency loss coupled with likely long-run economic efficiency losses due to the attenuated nature of property rights indicates the need for quite different ways of integrating reservoir and farm management. (See also W88-08658) (Author's abstract) W88-08657

COMPUTER UTILIZATION IN DISTRIBU-TION (L'UTILISATION DES ORDINATEURS DANS LA DISTRIBUTION),

Keuringsinstituut voor Waterleidingartikelen, Rijs-wijk (Netherlands). For primary bibliographic entry see Field 5F. W88-08920

OPTIMIZATION UNDER CERTAIN CONDI-TIONS OF WATER SYSTEMS CONTAINING PUMPING STATIONS (OPTIMISATION DANS CENTAINS CONTENTS DES AUGUSTICAL DES DESEAUX CERTAINES CONDITIONS DES RESEAUX D'EAU COMPORTANT DES STATIONS DE POMPAGE),

Azienda Comunale Elettricita ed Acque, Rome

For primary bibliographic entry see Field 5F. W88-08923

6B. Evaluation Process

DESCRIPTIVE STRUCTURE FOR WATER RE-SOURCE PLANNING, King Faisal Univ., Al-Hasa (Saudi Arabia). Water Studies Inst.

A.-M. Turjoman, and O. J. Helweg. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 289-295, April 1988. 4 tab, 25 ref.

Descriptors: *Planning, *Management planning, *Water resources development, Legal aspects, Economic aspects, Design criteria, Cost-benefit analysis, Mathematical studies, Equations, Political

Planners should tailor the way they approach a planning study to the particular situation or envi-ronment surrounding the study. In order to do this ronment surrounding the study. In order to do this more systematically, a descriptive structure that defines terms and categories of the planning environment is suggested. Corresponding terms and categories to define the planning approach as a first approximation are suggested. The planner can then tailor the planning approach to the specific study environment. Such an exercise should enhance the success of the planning effort. Defining the planning environment suggests a planning and the planning environment suggests a planning ap-proach. That is, a planner chooses the jurisdiction, scope, and stage of the planning environment. The planner then decides the kinds of control, coverplanner then decides the kinds of control, coverage, and rigidity the planning approach should take. It would be presumptuous to assume that correctly defining the planning approach were more important than the plan of implementation, or correctly carrying out other steps in the planning model. Again, it is important to emphasize that determining a planning approach by this method is an aid and is not, in any way, intended to be the final answer or replace the insight of the planner. (Alexander-PTT)

PROBABILISTIC BENEFIT-COST ANALYSIS OF A ZONING PROGRAM FOR FLOOD PLAINS,

Ecole Polytechnique, Montreal (Quebec). Dept. of Industrial Engineering.
For primary bibliographic entry see Field 6F.
W88-08041

ALTERNATIVES TO TRADITIONAL WATER DEVELOPMENT IN THE UNITED STATES, Environmental Policy Inst., Washington, DC. For primary bibliographic entry see Field 6F.

W88-08221

STREAM MANAGEMENT: EMERGING GLOBAL SIMILARITIES, Lund Univ. (Sweden). Stream and Bethic Ecology

Group For primary bibliographic entry see Field 5G. W88-08223

TOMORROW'S WATER MANAGER, Freshwater Foundation, Navarre, MN.

C. Olsenius Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 5, p 312-315, September-October

Descriptors: *Water management, *Water quality management, *Groundwater pollution, *Management planning, *Water demand, Water law, Government finance, Water conservation.

A continuous challenge to an increasingly complex and interrelated society is the problem of planning for the unknown future based on mindsets and paradigms of the present. This is of particular significance to such environmental issues as water management. There a number of social, political, economic, and environmental forces converging that will have far-reaching effects on water management in the U.S. Population shifts and increasing development in arid regions, shifting tenets in water law, declining groundwater supplies and groundwater quality, massive reductions in federal spending, and increased state control over water management are forcing changes in the way water is used, priced, and allocated. The critical question is how to allocate a limited water supply among growing agricultural, municipal, industrial, recreational, and environmental uses. Institutions are changing and must continue to change to meet emerging needs as we move from an era of unconemerging needs as we move from an era of uncon-strained growth to one that must focus more on equity, preservation, rehabilitation, conservation, and the best use of limited resources. Water planners must adopt approaches that are as integrated, comprehensive and fluid as the resource with which they work. (Sand-PTT)
W88-08377

WATER RESOURCES: DISTRIBUTION, USE, AND MANAGEMENT,

Delaware Univ., Newark. Dept. of Geography. J. R. Mather. John Wiley and Sons, Inc., New York. 1984. 439 p.

Descriptors: *Water resources management, *Water use, *Water supply, Hydrologic budget, Municipal water, Industrial water, Competing use, Agriculture, Water resources development, Legis-lation, Social aspects.

Control of limited sources of water in arid or semiarid regions creates immense political power and authority. Thus, both the politics and the legal aspects become of vital concern in any study of water resources. Knowledge of the politics and of the legal decisions that have been achieved in the the legal decisions that have been achieved in the regulation and control of water greatly aids in explaining the way water resources management has developed in a particular nation. While water is neither really created nor destroyed on the face of the earth (small quantities of new water or connate water may be formed in volcanic eruptions but it is a minor quantity in terms of the vast quantities of water now existing on the earth), it does not mean that this is always a fixed quantity everywher at all times. Both precinitation sunniversely. everywhere at all times. Both precipitation supplies and evapotranspiration demands vary markedly from place to place and from season to season. Treatment of the surface of the earth and of the atmosphere can influence the amount of precipitation, the conservation of water on the land, or the tion, the conservation of water on the land, or the way it is absorbed or runs off at the surface. The physical aspects of water and water management (the water problem, and the hydrologic cycle), the societal uses of water resources, obtaining additional supplies of water, management of water (legal, political, economic), and the future of water resources, are examined. (Lantz-PTT)

Cost Allocation, Cost Sharing, Pricing/Repayment—Group 6C

W88-08421

MANAGEMENT OF WATER PROJECTS: DE-CISION-MAKING AND INVESTMENT AP-

CISION-MAKING AND INVESTMENT AP-PRAISAL.
Organization for Economic Co-Operation and De-velopment, Paris (France).
Organization for Economic Co-Operation and De-velopment, Paris, France. 1985. 254 p.

Descriptors: "Water management, "Decision making, "Investment, "Planning, Economic aspects, Irrigation, Environmental effects, Water resources development, Social aspects, Europe.

sources development, Social aspects, Europe.

The beginnings of this book date back to 1970 when the Organization for Economic Cooperation and Development (OECD) observed that the Southern European countries were about to the Southern European countries were about to embark upon a large number of irrigation projects without adequate concern for the return they would yield and without attempting to define what markets there might be for the production the projects would make possible. The purpose of this book is to provide potential or actual promoters, as well as the experts of various disciplines, with the information which is needed to become a more knowledgeable manager. Part I is devoted to the general framework within which the studies in various disciplines take place. Chapter II sets out the whole set of studies which lead to the completion of a water project. Chapter III defines the basic vocabulary and principles which will be used throughout the document. Chapter IV describes the desirable institutional framework for achieving the task of building up a project. Chapter V considers the integration of the project into national and regional plans. Finally, Chapter VI deals with risk and uncertainty. Parts II, III and IV deal respectively with economics, social and environmental aspects. (Lantz-PTT)

GRAYS HARBOR ESTUARY MANAGEMENT

For primary bibliographic entry see Field 5G. W88-08512

NEW HAMPSHIRE COASTAL PROGRAM OCEAN AND HARBOR SEGMENT AND FINAL ENVIRONMENTAL IMPACT STATE-MENT.

MENI. National Oceanic and Atmospheric Administra-tion, Washington, DC. Office of Coastal Zone Management.

For primary bibliographic entry see Field 5G. W88-08513

WATER RESOURCES: PLANNING AND MAN-AGEMENT, O. J. Helweg. John Wiley and Sons, New York. 1985. 364 p.

Descriptors: *Water resources planning, *Social aspects, *Water resources management, Management planning, Mathematical studies, Engineering,

This book introduces the major topics of water resources planning in one volume. It is designed primarily as a university text, but may also be of use to practicing engineers, planners, environmen-talists, and administrators. Numerous solved exam-ples reinforce and introduce material in the text, and the collections of selected problems at the end and the collections of selected properties at the chapters are designed to simulate planning studies. The text uses economics and systems analysis but provides appendices for those who require a brief introduction. Although this text is written brier introduction. Attnough tim text is without from an engineering perspective, the technical and mathematical material has been simplified in order to make the book useful to nonengineers. Through to make the book useful to nonengineers. Inrough-out, the basic principles presented are applicable to both developed and developing countries. This book considers planning as the umbrella under which systems analysis, economics, and other such disciplines may be carried out. Planners must be more than optimizers (although they should opti-mize), and they must do more than maximize net

benefits (although they should also do that). Planners need to be able to integrate all these tools to achieve the best possible future with limited resources. To achieve such an integration, many nontechnical subjects have been included here, some of which might seem more appropriate in a sociology text. Nevertheless, it is increasingly necessary for water resources planners to utilize non-technical subjects because they, more than engineering analysis, may determine the success or failure of a planning effort. (Lantz-PTT) W88-08543 benefits (although they should also do that). Plan-

SINGLE DECISION-MAKER APPROACH TO IRRIGATION RESERVOIR AND FARM MAN-AGEMENT DECISION MAKING, New South Wales Univ., Kensington (Australia).

School of Economics.
For primary bibliographic entry see Field 6A.
W88-08656

CAPACITY SHARING OF WATER RESER-

VOIRS, New South Wales Univ., Kensington (Australia). School of Economics. For primary bibliographic entry see Field 6E. W88-08658

PROTOCOL FOR THE SELECTION OF PROCESS-ORIENTED REMEDIAL OPTIONS TO CONTROL IN SITU SEDIMENT CONTAMI-

International Joint Commission-United States and Canada, Windsor (Ontario).

For primary bibliographic entry see Field 5G. W88-08869

PERFORMANCE EVALUATION OF AN ACTI-

VATED SLUDGE PROCESS USING A PER-SONAL COMPUTER SPREAD SHEET, Johannesburg City Health Dept. Labs. (South Africa). For primary bibliographic entry see Field 5D. W88-08905

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

APPLICATION OF INVESTMENT TIMING ANALYSIS: DUAL WATER SYSTEMS, Marsan (Andre) et Associes, Inc., Montreal (Quebec). For primary bibliographic entry see Field 3C. W88-08029

WATERBUSTING: IRRIGATION INVEST-MENT AGGRAVATES COMMODITY SUR-PLUSES, For primary bibliographic entry see Field 3F. W88-08380

PRICING OF WATER SERVICES.

Organization for Economic Co-Operation and Development, Paris (France).
Organization for Economic Cooperation and Development, Paris, France. 1987. 145 p. 20 tab, 116 ref.

Descriptors: *Pricing, *Water use, *Water rates, Political aspects, Tariffs, Water supply, Economic aspects, Water costs, OECD.

Water is both an environmental resource and a commodity. The price that should be paid for water in its various uses has become the subject of public debate in the Organization for Economic public debate in the Organization for Economic Cooperation and Development (OECD) countries. This report investigates the arguments, reviews existing practices and puts forward various options for economically rational pricing practices which would, at the same time, lead to environmentally acceptable results. In Chapter II, it is stated that ideally, water services should be provided in an economically and environmentally efficient manner so that the net benefits to the community

as a whole are maximized. In Chapters III to VIII the major water services - piped supply and dis-posal, and direct abstractions and discharges -- are explored in much more detail and the relevant experiences of OECD Member states are compared. Two phenomena are highlighted: (1) the inefficiency of flat-rate pricing systems, when no volumetric charge confronts the consumer (switching to a metering system is dealt with in Chapter VIII); and (2) the prevalence of various forms of average cost pricing often incorporated into a two or multi-part tariff. Although not fully satisfying efficiency requirements, the political attractiveness of increasing-block tariffs was recognized. In an increasing cost industry the highest-priced block may be fixed approximately at marginal cost and lower-priced tranches used to ensure that gross revenue does not exceed financial requirements.
The User-Pays Principle, which embraces the more familiar Polluter-Pays Principle, ensures that a financial incentive exists for the water service user to avoid waste. This remains true even in the presence of sometimes significant subsidies, espe-cially of capital costs (as noted in Chapter IX). A general decline of subsidization has been in evi-dence. A change towards a more rational tariff structure is often not a painless process. Chapter X the income redistributional and environmental costs that may result are listed and the methods by which water authorities and water legislation have attempted to cope with such problems are dis-cussed. (Lantz-PTT) W88-08414

SAFE DRINKING WATER ACT COST IM-PACTS ON SELECTED WATER SYSTEMS, CWC-HDR, Inc., Santa Ana, CA.

For primary bibliographic entry see Field 5G. W88-08428

REMOVING IMPEDIMENTS TO WATER MARKETS.

Brigham Young Univ., Provo, UT. Dept. of Eco-

B. D. Gardner. Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 6, p 384-388, November-December

Descriptors: "Water markets, "Water exchange, "Intervasin transfers, "Water transfer, "Economic aspects, "Political aspects, "Legal aspects, Irriga-tion water, Institutional constraints, Water supply systems, Policy, Western United States.

Until recently it was mostly economists who advocated voluntary market exchanges of water in the West and elsewhere. These exchanges, or transfers as they are sometimes called now, are being unedly recommended by water users, politicians, bureaucrats, and even environmental organicains, our caucrais, and even environmental organi-zations who have come to see their value for achieving a more efficient water allocation. Mar-kets are now allocating water more efficiently at many western locations, for example, between irrigation companies in Utah's Lower Sevier River Basin, hetw een individual irrigators in a host of irrigation districts in California, and between agricultural and municipal water users in the Tucson, Arizona, area. But many impediments remain to market transfers. Some of these impediments will prove quite durable. In the West, water is wealth, and water transfers represent transfers of wealth. They also represent increases in wealth as water moves to more valuable uses. Because the federal and state governments are playing increasing roles in water development and allocation, it is especially encouraging to see a philosophical commitment to water markets by the U.S. Dept. of Interior. Vigorous efforts are needed now to bring law and administrative practice into line with the stated philosophy. Subsequent federal administrations may not be as sympathetic to markets. In addition, state policy should be speedily brought into line with the emerging federal policy. (Alexander-PTT)

W88-08618

Field 6-WATER RESOURCES PLANNING

Group 6C-Cost Allocation, Cost Sharing, Pricing/Repayment

RESULTS OF THE QUESTIONNAIRE CON-CERNING THE USE OF DOMESTIC WATER-METERS (RESULTATS DU QUESTIONNAIRE CONCERNANT L'UTILISATION DES COMP-TEURS A EAU DOMESTIQUES),

Aqua AQUAAA, No. 1, p 7-8, January 1988. 1 tab.

Descriptors: *Water metering, *Surveys, *Water use, *Domestic water, Questionnaires, International studies, Public opinion, Europe, Asia, America,

In 1985, a questionnaire on the use of domestic water meters was distributed to about 40 cities in Europe, Asia, America and Australia. Among the questions investigated were (1) the quantity of domestic water, (2) the criteria water use payment, (3) the measurement methods used in blocks of apartments, and (4) the kind of domestic water meters. This paper analyzes the results from 24 countries and discusses meter water quantity, payent criteria and measurement methods. Accordcountries and accuses meter water quantity, pay-ment criteria and measurement methods. Accord-ing to the majority of answers, the use of water meters in every apartment was considered point-less. (Miller-PTT) W88-08919

6D. Water Demand

RESIDENTIAL WATER DEMAND IN METRO MANILA, L. C. Palencia

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 275-279, April 1988. 1 tab, 17 ref.

Descriptors: *Municipal water, *Water demand, *Manila, Model studies, Statistical methods, Mathematical studies, Domestic water, Econometric, Regression analysis, Time series analysis, Water consumption, Economic aspects, Management planning, Philippines.

An econometric demand function is estimated for residential water use in Metropolitan Manila. Regression results using annual time series data from 1970 to 1981 show that residential water consumption responds to changes in economic variables. Residential demand showed an income (household) elasticity of 0.542 and a combined price elasticity of -0.287. Implications for planning and management are discussed. (Author's abstract) W88-08033

PRIVATIZING THE GROUND WATER RE-SOURCE: INDIVIDUAL USE AND ALTERNA-TIVE SPECIFICATIONS

California State Univ.-Northridge. Dept. of Eco-

For primary bibliographic entry see Field 6E. W88-08048

POTENTIAL EXPANSION AND WATER DEMAND OF RIPARIAN-BASED IRRIGA-

TION, Florida Univ., Gainesville. Dept. of Agricultural

Engineering.
G. Vellidis, B. B. Ross, and D. B. Taylor. American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1726-1732, November-December 1987. 3 fig, 5 tab, 12 ref.

Descriptors: *Water demand, *Irrigation water, *Model studies, *Irrigation engineering, Economic aspects, Cost-benefit analysis, Regional analysis, Pamunikey River, Virginia, Prediction, Financial feasibility, Water consumption.

Several critical irrigation water use areas in Virginia have been identified. A method for determining the feasibility of large-scale irrigation was used to estimate potential irrigation expansion and water demand in one of these areas, the Pamunkey River demands in one of trees areas, the rantimery several passin. The approach utilized a grid-based geographic information system for spatial evaluation of irrigation development potential. Proposed irrigation systems were then evaluated with respect to economic feasibility, after agronomic and engineer-ing constraints were considered. The results of 20

scenarios are presented involving variations in scenarios are presented involving variations in crop price, investment interest rate, and benefit-cost ratio. For each scenario evaluated, the total number of feasible systems and resultant irrigated area, as well as cumulative pumping demand and seasonal water consumption, are quantified for the Pamunkey River area. Results indicate that future water use colicts are likely in the region. (Author's W88-08066

CAPACITY SHARING OF WATER RESER-

VOIRS, New South Wales Univ., Kensington (Australia). School of Economics.

For primary bibliographic entry see Field 6E. W88-08658

RESULTS OF THE QUESTIONNAIRE CON-CERNING THE USE OF DOMESTIC WATER-METERS (RESULTATS DU QUESTIONNAIRE TEURS A EAU DOMESTIQUES). For primary bibliographic entry see Field 6C. W88-08919

6E. Water Law and Institutions

PRIVATIZING THE GROUND WATER RE-SOURCE: INDIVIDUAL USE AND ALTERNA-TIVE SPECIFICATIONS,
California State Univ.-Northridge. Dept. of Eco-

D. T. Fractor.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 405-412, April 1988. 4 fig, 1 tab, 22 ref,

Descriptors: *Property rights, *Privatization, *Groundwater management, *Water resources development, Model studies, Management planning, Mathematical studies, Prediction, Groundwater availability, Aquifers.

While most inquiries into improving the efficiency of ground water allocation have focused upon various schemes involving centralized manage-ment, recently the focus has shifted towards exploring private property solutions to these prob-lems. However, most of these studies, when model-ing ground water use, have equated behavior under private property to that under common property conditions. This leads to the possible misproperty conditions. This leads to the possible mistaken conclusion that private property rights do not promote more efficient ground water use, because these models assume that producers ignore the future effects of current pumping. This paper attempts to correct this deficiency by formally modeling ground water use under common property, central management, and private property secnarios. Moreover, there are many ways that property set as the property secnarios of the property secnarios of the property of the property rights can be defined over ground water, some establishing more exclusivity over the resource than others. Four specifications of property rights are analyzed for their likely effects on allocative efficiency: full stock-flow, partial stock-flow, limited stock-flow, and pure flow rights. (Author's abstract) abstract) W88-08048

WATER RESOURCES MANAGEMENT: THE

SOCIO-POLITICAL CONTEXT, B. S. Sadler, and W. E. Cox. Water Resources Journal, No. 155, p 14-22, December 1987. 5 fig.

Descriptors: *Institutional constraints, *Social aspects, *Political aspects, *Water resources development, *Management planning, Information exchange, Economic aspects, Salinity, Hydrology,

Using the salinity problem of south-western Australia as a case-study, the authors show how waterresources management has as much to do with socio-political factors as it does with hydrological processes. Although resource conditions and cultural institutions may vary from place to place,

some general factors appear to be universally applicable: that the management perspective adopted to be adequate for decision-making, and that there be awareness among public officials and the general public of both water problems and management options. Without local support and approval, many water-management activities are not feasible. It is for this reason that good public information about issues may be critical. The authors have both participated in an International Hydrological Program (IHP) working group on the role of water resources in socio-economic development and on related public information aspects. Two publications, edited by them and representing the main outcome of the respective IHP project, will be published by the United Nations Educational, Scientific and Cultural Organization in 1987. (Auentific and Cultural Organization in 1987. (Author's abstract) W88-08085

WATER-RELATED LIMITATIONS TO LOCAL DEVELOPMENT,

Swedish Natural Science Research Council, Stock-

For primary bibliographic entry see Field 4C. W88-08226

HAZARDOUS WASTE LAW AND PRACTICE. Vanderbilt Univ., Nashville, TN. School of Law For primary bibliographic entry see Field 5G. W88-08506

HAZARDOUS WASTE REGULATION HAND-BOOK: A PRACTICAL GUIDE TO RCRA AND SUPERFUND,

Wald, Harkrader and Ross, Washington, DC For primary bibliographic entry see Field 5G. W88-08515

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION I.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08516

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION II.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08517

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION III.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08518

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION IV.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08519

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION V.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08520

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION VI.

National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A.

Nonstructural Alternatives—Group 6F

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION VII. National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08529.

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION VIII. National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08523

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION IX. National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-0852

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION X. National Water Well Association, Dublin, OH. For primary bibliographic entry see Field 7A. W88-08325.

IS FEDERAL FUNDING THE ANSWER TO WATER SUPPLY NEEDS, Smith and Loveless, Inc., Lenexa, KS. For primary bibliographic entry see Field 5G. W88-08551

DRINKING WATER ACT: A CAUSE FOR IN-NOVATION, R. P. O'Brien, and M. M. Clemens. Water Engineering and Management WENMD2, Vol. 135, No. 3, p 24-25, March 1988.

Descriptors: "Water treatment, "Safe Drinking Water Act, "Drinking water, "Water quality, "Public policy, "Regulations, "Water treatment," "Disinfection, Radionuclides, Pollutants, Lead, Mi-crobial contaminants, Contamination, Surface water, Groundwater, U.S. Environmental Protec-

tion Agency.

The Safe Drinking Water Act Amendments of 1986 mandate a number of new or expanded regulatory initiatives and have given the EPA significant new powers in addition to the requirement that all public water supplies meet the National Primary Drinking Water Regulations. The EPA has indicated that the key priorities in their regulatory agenda are: radionuclides, lead, microbial contaminants, and disinfection by-products. The EPA will set maximum contaminant levels (MCLs) for these compounds based on three criteria (1) the health goal established for the particular contaminant, (2) the effectiveness of technologies in removing the contaminant, and (3) the level of treatment affordable by the large water supply systems. The MCL is to be set as close as possible to the health goal using the most effective and affordable technology available. This technology, termed the best available technology (BAT), must be selected before a MCL can be established. The BAT development and selection process must be flexible and contain provisions for continuing technology review, so that evolving technologies are properly recognized. It is imperative that the technology does not place an undue risk on the utility conducting the test, or an impossible burden on the developer. (Roseman-PTT)

CAN THE WATER ADDITIVES PROGRAM MEET THE STRUGGLE OF SELF REGULA-TION, Smith (A.O.) Harvestore Products, Inc., DeKalb,

F. Grillot.

Water Engineering and Management WENMD2, Vol. 135, No. 3, p 26-27, March 1988.

Descriptors: *Water treatment, *Water quality, *Regulations, *Public health, *Drinking water,

Additives, Pollutants, Water pollution, U.S. Environmental Protection Agency.

In May 1984, the EPA solicited bids from the private sector to establish a drinking water additives program. Only one proposal was received. The project was awarded in September to a consortium headed by the National Sanitation Foundation (NSF) of Ann Arbor, Michigan. The issues which should concern all sectors of the drinking water industry include the following: Should a private sector organization with a direct profit motive be in a position of setting maximum contaminant levels (MCLs) for additives. Should any organization other than the EPA be charged with such responsibility; By law costs must be taken into account when the EPA sets drinking water standards but the method established by NSF for setting health effects does not include any cost/benefit analysis, Before any standards are formalized mutual agreement must be reached by industry and a testing/certification mechanism must be in place for obtaining product approvals. We must progress from here and arrive at a cost-effective, reliable and acceptable system to all parties for additives control. (Roseman-PTT)

CAPACITY SHARING OF WATER RESER-CAPACITY
VOIRS,
New South Wales Univ., Kensington (Australia).
School of Economics.
N. J. Dudley, and W. F. Musgrave.
Water Resources Research WRERAO, Vol. 24,
No. 5, p 649-658, May 1988. 1 fig, 2 tab, 3 ref.

Descriptors: "Capacity sharing, "Reservoir operation, "Resource allocation, "Reservoir releases, "Riparian rights, "Water rights, "Model studies, Optimization, Decision making, Irrigation programs, Computer models, Farm management, Management planning.

The concept of a water use property right was developed which does not apply to water volumes as such but to a share of the capacity (not contents) of river storage reservoirs and their inflows. The shareholder can withdraw water from their share over time in accordance with their preferences for stability of water deliveries. The reservoir authority does not manage reservoir releases but keeps records of individual shareholder's withdrawals and set influes to monitor the unantity of water in and net inflows to monitor the quantity of water in each shareholder's capacity share. A surplus of total reservoir contents over the sum of the contents of the individual shareholder's capacity tents of the individual shareholder's capacity shares will accrue over time. Two different criteria for its periodic distribution among shareholders are compared. A previous paper by Dudley noted a loss of short-run economic efficiency as reservoir and farm management decision making become separated. This is largely overcome by capacity sharing which allows each user to integrate the management of his portion of the reservoir and his farming operations. The nonattenuated nature of the capacity sharing water rights also promotes long-run economic efficiency. (See also W88-08658)

EXPANDING ROLE OF NATURAL RE-SOURCE DAMAGE CLAIMS UNDER SUPER-FUND. F. H. Habicht.

Virginia Journal of Natural Resources Law, Vol. 7, No. 1, p 1-26, Fall 1987.

Descriptors: *Water pollution effects, *Legal aspects, *Superfund, *Waste disposal, *Landfills, *Damage, Liability.

The 1986 Superfund Amendments and Reauthorization Act (SARA) significantly changes the role of natural resource damage claims. SARA places new limits on the permissible uses of natural resource damage awards and prohibits the use of the Superfund to pay for restoring natural resources. Consequently, natural resource trustees must now look to parties responsible for the contamination to finance restoration. Moreover, regulations for damage assessment give the force of a rebuttable

presumption in actions to recover natural resource damages. A reasonable approach to deal with po-tential liability under the Superfund law is presented. Although the federal government is primarily concerned with the protection of public health and the environment, there are some situations where the government is likely to seek recovery of damthe government is likely to seek recovery of dam-ages: (1) when significant harm has occurred to a natural resource and cleanup is not feasible or cost-effective and (2) when cleanup does not restore the destroyed resources within a reasonable time. The specific statutory provisions regarding natural re-source damages are described—who can sue, who may be liable, and the elements of liability, as well as how to measure damages. The details of the Department of Interior's Section 301 regulations for are discussed. These are complicated but they Department of Interior's Section 301 regulations for are discussed. These are complicated, but they do provide a flexible and predictable analytical process. Although the regulations have not yet been applied to any damage assessments, some related legal issues (interpretation of Section 107(f) of the Superfund law) are discussed as they may apply to future litigation. Potentially responsible parties can take several actions to control damage costs: (1) Participate in the Superfund remedy selection process, seeking to have the response action address as many of the injuries to natural resources as is feasible and minimizing the extent of residual damages. (2) Participate in performing the response and reduce liability by achieving a prompt settlement. (3) Move rapidly to mitigate any injuries to natural resources that may be in process. (Cassar-PTT) W88-08749

MEDIATED SETTLEMENT OF ENVIRON-MENTAL DISPUTES: GRASSY NARROWS AND WHITE DOG REVISITED,

Windsor Univ. (Ontario). Faculty of Law I. West

ental Law, Vol. 18, No. 1, p 131-150, Fall 1987 55 ref

Descriptors: *Mediated settlements, *Water law, *Legal aspects, *Water pollution effects, *Human population, *Mercury, *Ecological effects, Grassy Narrows, White Dog, Water pollution sources,

The subject of this dispute involved the tragic and highly publicized methyl mercury contamination of the English-Wabigoon River system. This article argues that mediated settlements of environmental disputes appear to provide the best mechanism available to allow victims of environmental harm to be compensated. Because procedural and evidentiary rules in environmental private actions are biased in favor of the polluter, traditional tort litigation has failed to address the real inequities caused by environmental legislation and the apparent unwillingness of the judiciary to evolve existing law are also part of the problem. The recent settlement of a longstanding lawsuit between Grassy Narrows and White Dog Ojibway Bands and the polluter is examined to determine if this unique settlement achieved through mediation can serve as a model for future environmental disputes. (Alexander-PTT) disputes. (Alexander-PTT) W88-08854

PENNSYLVANIA'S GROUND WATER QUALITY PROTECTION PROGRAM,

Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management. For primary bibliographic entry see Field 5G. W88-08903

6F. Nonstructural Alternatives

PROBABILISTIC BENEFIT-COST ANALYSIS OF A ZONING PROGRAM FOR FLOOD PLAINS,

Ecole Polytechnique, Montreal (Quebec). Dept. of Industrial Engineering. D. Leblanc, and P. Ouellette.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 341-345, April 1988. 3 tab, 5 ref.

Field 6-WATER RESOURCES PLANNING

Group 6F—Nonstructural Alternatives

Descriptors: Cost-benefit analysis, *Flood plain zoning, Statistical methods, Flood control, Model atudies, Mathematical studies, Prediction, Hydrology, Floods.

Various techniques, one of which is zoning, are used to control the extent of flood damage. The benefit-cost analysis of zoning programs must take into account the random nature of flooding. This paper outlines a method for determining not only the expected value of the benefit-cost ratio, but also the probability of such a zoning program being profitable. It also presents an application of the method to the assessment of the Outaouais Regional Community zoning program. (Author's abstract)

ALTERNATIVES TO TRADITIONAL WATER DEVELOPMENT IN THE UNITED STATES, Environmental Policy Inst., Washington, DC. B. Blackwelder, B. L. Harding, and T. Colborn. AMBIO AMBOCX, Vol. 16, No. 1, p 32-37, 1987. 2 fig. 20 ref.

Descriptors: *Water development, *Construction, *Leases, *Water shortage, *Flood control, *Water supply, *Recreation, *Irrigation, *Hydroelectric power, Colorado River basin, Design criteria, Economics.

Approaches to avoid the problems associated with traditional federal water construction projects in the U.S. are discussed. A variety of nontraditional and nonstructural alternatives are described, including long-term leasing of water across state borders to alleviate future water shortages in the Colorado River Basin. Nonstructural alternatives includes those projects that rely on appropriate land use, better building design, demand management and increased efficiency in water and energy use to meet the needs of flood control, water supply, recreation, irrigation, and hydropower. These alternatives should be very attractive to both developed and developing countries because they involve less capital investment, environmental damage, and social disruption. (Author's abstract) W88-0822

MEETING DROUGHT: A MICRO WATER-SHED DEVELOPMENT APPROACH, Tata Inst. of Fundamental Research, Bombay (India). B. M. Udgaonkar, and V. D. Deshpande.

B. M. Udgaonkar, and V. D. Deshpande. AMBIO AMBOCX, Vol. 16, No. 5, p 301-303, 1987.

Descriptors: *Drought, *Watershed management, *Economic development, *Developing countries, Social aspects, Management planning, Farming, Irrigation, India, Organizations, Capital costs, Social adjustment.

In the Maharashtra state in India, about one-third of the land and population are affected by recurring drought conditions. A micro watershed development approach has been undertaken by the Pani Panchayat, or water council, which provides for effective, efficient, and equitable use of water. Under this system, lift irrigation schemes are undertaken for groups of dry-land farmers only, not for individuals, thus fostering community spirit. Water is shared equitably, according to the size of the family, and not in proportion to the landholding. Water rights are not transferable with land; if land is sold the rights revert to the Pani Panchayat, thus preventing land speculation. The beneficiaries share 20% of the capital cost of any lift irrigation project, according to their share of water; the other 80% is in the form of a government subsidy or an interest-free loan. The beneficiaries must administer and operate all aspects of the project. Growing those crops which consume considerable amounts of water is forbidden, which makes protective irrigation of a larger area of seasonal crops possible. The landless can also share water and can, consequently, be fully employed in the village itself, by becoming sharecroppers to farmers who own more land; this would check migration to the cities. The emphasis of this program is on increasing the production capacity of the average poor

farmer, i.e, on production by the masses rather than on mass production. This program shows how poor farmers who have no irrigation facilities can be mobilized and organized and how, with technical assistance and credit, they can meet recurring drought. (Sand-PTT) W88-08229

NORWEGIAN RIVER PROTECTION SCHEME: A REMARKABLE ACHIEVEMENT OF ENVIRONMENTAL CONSERVATION, Norges Landbrukshoegakole, Ass. Dept. of Nature Conservation.

S. Huse. AMBIO AMBOCX, Vol. 16, No. 5, p 304-308, 1987. 3 fig, 10 ref.

Descriptors: *Water resources development, *Hydroelectric power, *Rivers, *Water conservation, *River protection, Natural resources, Economic development, Norway, Economics, Agriculture.

The hydropower-producing potential of Norway's rivers represents one of the country's most valuable economic resources, and has been a key factor in the transition of Norway from an agricultural to an industrial society. The efforts to set aside a number of representative river systems for purposes other than hydropower development have been one of the dominating environmental issues for the past few decades. This article discusses Norway's national river protection scheme and the complex issues which arise in the debate on natural resource conservation versus economic development. (Sand-PTT)

TARGETING TO PROTECT GROUNDWATER QUALITY,
Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
For primary bibliographic entry see Field 5G. W88-08378

REMOVING IMPEDIMENTS TO WATER MARKETS, Brigham Young Univ., Provo, UT. Dept. of Economics.
For primary bibliographic entry see Field 6C. W88-08618

6G. Ecologic Impact Of Water Development

ECOREGIONS: AN APPROACH TO SURFACE WATER PROTECTION, For primary bibliographic entry see Field 5G. W88-8004

ENDANGERED WOUNDFIN AND WATER MANAGEMENT IN THE VIRGIN RIVER, UTAH, ARIZONA, NEVADA, Nevada Univ., Las Vegas. Dept. of Biological

J. E. Deacon. Fisheries, Vol. 13, No. 1, p 18-24, January-February 1988. 1 fig. 7 tab, 13 ref.

Descriptors: *Woundfin, *Virgin River, *Limnology, *Aquatic habitats, *Water resources development, Species composition, Reproduction, Population dynamics, Survival, Endangered species, Flow, Water management, Utah, Arizona, Nevada.

Attempts to define conditions permitting compatible existence of endangered fishes and water development projects in the Virgin River basin of Utah, Arizona, and Nevada have met with limited success. The Quail Creek water project was completed in 1985 following acceptance of conditions judged essential to ensure survival of woundfin. Flow requirements specified for that project, however, may have been violated almost constantly in June-October 1985 and June-September 1986. In late May 1985 the entire Virgin River immediately below the Quail Creek diversion structure disappeared into sink holes that developed in the river

bed. At about that time discharge into the river bed from the hot saline Pah Tempe springs located about 4.4 km downstream increased from 0.3 to an estimated 0.85-1.2 cu m/sec. Native fish populations declined throughout the Utah segment of the Virgin River in 1985 and reproduction was poor to nonexistent above Quail Creek. Some species recovered and reproduced well following improvements in water quality in 1986. During 1985-86 the exotic red shiner became the dominant species throughout the Arizona-Nevada reach of the Virgin River while native species declined. Management of endangered species in the Virgin River requires a continuous flow of information on population status, habitat requirements, and biotic interactions that must be integrated into the numerous water management activities in the system. (Author's abstract) W88-08084

WATER RESOURCES MANAGEMENT: THE SOCIO-POLITICAL CONTEXT, For primary bibliographic entry see Field 6E. W88-8080.

SALINIZATION OF RIVERS AND STREAMS: AN IMPORTANT ENVIRONMENTAL HAZARD,

Adelaide Univ. (Australia). Dept. of Zoology. For primary bibliographic entry see Field 5B. W88-08224

DEVELOPMENT AND BIOLOGICAL STATUS OF LAKE KARIBA - A MAN-MADE TROPICAL LAKE.

Moi Univ., Eldoret (Kenya).
L. Ramberg, S. Bjork-Ramberg, N. Kautsky, and C. Machena.
AMBIO AMBOCX, Vol. 16, No. 6, p 314-321, 1987. 4 fig. 1 tab, 55 ref.

Descriptors: *Lakes, *Reservoirs, *Succession, Ecosystems, Biomass, Benthic flora, Benthic fauna, Lake Kariba, Zimbabwe, Limnology.

The presently dominating plants and animals and their biomasses in the man-made Lake Kariba are described for the major subsystems: the inundation zone, the littoral zone, the submerged tree zone and the pelagic zone. Since earlier investigations, undertaken in the 1960s, large changes have occurred in the biota of most subsystems. Invasions of several new species have occurred with consequent chain effects throughout the ecosystem. Lake adapted species are replacing the originally riverine flora and fauna. Large yearly water-level fluctuations do not seem to have hampered the functioning of the lake ecosystem. However, during the drawdown period large quantities of invertebrates are stranded and devoured by terrestrial scavengers. (Author's abstract)

FAULT STABILITY CHANGES INDUCED BENEATH A RESERVOIR WITH CYCLIC VARIATIONS IN WATER LEVEL,

Geological Survey, Menlo Park, CA. E. A. Roeloffs.

E. A. ROEIOIIS. Journal of Geophysical Research JJGBDU, Vol. 93, No. B3, p 2107-2124, March 10 1988. 12 fig, 2 tab, 29 ref, append. USGS Contract 14-08-0001-22022.

Descriptors: *Reservoirs, *Seismology, *Water level, *Geologic fractures, *Rock mechanics, *Reservoir sites, *Reservoir stages, *Water level fluctuations, Faults, Fault stress, Fault stability, Earthquakes, Induced seismicity, Seismic studies, Pore pressure, Biot equation, Elastic deformation equation, Pore fluid flow equation, Lake Mead, USA.

Reservoir impoundment apparently produces earthquakes by triggering slip on preexisting faults subject to near-critical tectonic stress. Lake Mead has been a site of induced seismicity since shortly after it began to fill. If it is remarkable that stress and pore pressure changes produced by impound-

Network Design-Group 7A

ing a full reservoir can trigger earthquakes, then it is even more remarkable that annual fluctuations in reservoir level can modify the induced seismicity. The stress and pore pressure changes produced by a steady periodic variation of water-level on the surface of a uniform porous elastic half-space were evaluated using the fully coupled (Biot) equations of elastic deformation and pore fluid flow. Diverse choices of material properties gave a coupled stress field differing from the elastic stress field by at most 0.035 times the water pressure at the bottom of the reservoir. Peak coupled, pore pressure change can lag peak water level. The maximum lag increases as B decreases, where B is the ratio of pore pressure increase to mean compressive stress increase under undrained conditions. Directly beneath the reservoir peak pore pressure in the annual cycle can lag peak water level most 10 days if B = 0.80, but can lag by up to 122 days if B = 0.11. B and c also influence the timing of the greatest destabilization. If B and c are low, maximum destabilization at low water level is possible for faults that are stabilized by the weight of the reservoir; this mechanism may have operated at Lake Mead. The fully coupled solution was compared with an uncoupled solution, with a solution that is coupled but which assumes incompressible solid and fluid constituents (consolidation) and with a decoupled solution in which the difference between the pore pressure field and B times the elastic mean compressive stress obeys a homogeneous diffusion equation. The uncoupled and consolidation solutions respectively underestimate and overestimate pore pressure furing short-term reservoir level fluctuations. The decoupled solution for the problem studied here. (Miller-PTT)

PACIFIC NORTHWEST RIVERS STUDY: AS-SESSMENT GUIDELINES, MONTANA, Montana Dept. of Fish, Wildlife and Parks, For primary bibliographic entry see Field 2E. W88-08409

ARCHAEOMAGNETIC DATES AND THE HO-HOKAM PHASE SEQUENCE. Colorado State Univ., Fort Collins. Dept. of An-

Colorado State Univ., Fort Collins. Dept. of Anthropology.

J. L. Eighmy, and R. H. McGuire.

Available from the National Technical Information
Service, Springfield, VA. 22161 as PB88-185012.

Price codes: A05 in paper copy; A01 in microfiche.
Bureau of Reclamation Report No. DI-BR-APOCCRS-88-3, February 1988. 88 p, 33 fig, 6 tab, 35
ref, 3 append. Bureau of Reclamation Contract No.
7-PG-32-12570.

Descriptors: *Archaeology, *Hohokam, Anthropology, Indians, Social aspects, Magnetic studies.

pology, Indians, Social aspects, Magnetic studies. Few things in Southwestern archaeology are so widely and hotly contested as the Hohokam phase sequence and chronology. The reanalysis of 695 Hohokam archaeomagnetic samples has shown that the mean phase virtual geomagnetic pole (VGP) locations fall very close to the master Southwest VGP curve in their correct relative order. By averaging the sets of individual archaeomagnetic dates, reasonable estimates of mean phase dates are produced. Using these means and date ranges, a final archaeomagnetic chronology was produced. The chronology does not completely support any previously proposed chronology. With respect to the Phoenix Basin, little support is evident for the early portion of one long chronology. On the other hand, the Soho phase in the archaeomagnetic chronology (the Schiffer chronology). In the Tucson Basin, the archaeomagnetic chronology does not support the Schiffer placement of the Rillito phase, and the archaeomagnetic chronology goes not support the Schiffer placement of the Rillito phase, and the archaeomagnetic chronology goes not support the Schiffer placement of the Rillito phase, and the archaeomagnetic chronology goes of the support than most of the previously proposed chronologies. (Lantz-PTT)

DISTRIBUTION AND RELATIVE ABUN-DANCE OF THE NILE PERCH (LATES NILO-

TICUS (L.) PISCES: CENTROPOMIDAE) IN LAKE KAINJI, NIGERIA, Kainji Lake Research Inst., New Bussa (Nigeria). Por primary bibliographic entry see Field 2H. W88-08583

IMPACT OF HYDROELECTRIC DEVELOP-MENT ON THE AMAZONIAN ENVIRON-MENT: WITH PARTICULAR REFERENCE TO THE TUCURUI PROJECT, University Coll. of Swansea (Wales). Centre for Development Studies.

Development States. C. Barrow. Journal of Biogeography JBIODN, Vol. 15, No. 1, p 67-78, January 1988. 2 fig. 2 tab, 55 ref.

Descriptors: *Dam effects, *Environmental impact assessment, *Amazon, *Tucurui project, *Hydro-electric power, *Ecological effects, *Dam con-struction, Catchment areas, Brazil, Dams, Tropical

Brazil has begun to exploit the hydroelectric potential of Amazonia. The Tucurui Dam is the first
of many large hydroelectric projects planned for
Amazonian Brazil to be completed. Without doubt,
the environmental impact assessment studies carried out at Tucurui have great value for planning
future Amazonian (and other humid tropical) hydroelectric projects. A review of information on
the environmental impacts of the Tucurui Project
is presented together with observations made by
the author during field visits to the Tocantina Basin
and Belem region in 1981, 1983 and 1983. It is
concluded that there is a need for more study of
impacts downstream of Tucurui, also for some
assessment of the effects of increasing the number
of turbines operating there, and for an examination
of why some predicted difficulties have not in
practice been avoided. An attempt is made to
gather together the available information on other
hydroelectric projects under construction or proposed for construction in Amazonian Brazil. (Author's abstract) posed for const thor's abstract) W88-08604

ABUNDANCE OF YOUNG BROWN SHRIMP IN NATURAL AND SEMI-IMPOUNDED MARSH NURSERY AREAS: RELATION TO TEMPERATURE AND SALINITY,

ent Station, Baton Rouge. For primary bibliographic entry see Field 2L. W88-08750

EFFECTS OF IMPOUNDMENTS AND WATER POLLUTION ON INVERTEBRATE COMMUNITIES IN RIVERS AND PLAINS OF THE HARZ MOUNTAINS (WIREUMG VON TALSPERREN UND GEWASSERBELASTUNG AUF INVERTEBRATENGESELLSCHAFTEN FLIEBGEWASSERN UND AUEN

HARZES),
Technische Univ. Braunschweig (Germany, F.R.).
Zoologisches Inst.
For primary bibliographic entry see Field 5C.
W88-08820

FACTORS CONTROLLING PRIMARY PRODUCTION IN TWO RIVERS RESULTING FROM A REDUCTION IN FLOW, (FACTEURS CONTROLANT LA PRODUCTION PRIMAIRE DANS DEUX RIVIERES SOUMISES A UNE FORTE REDUCTION DE DEBIT, Quebec Univ., Montreal. Dept. of Biological Sciences

For primary bibliographic entry see Field 2H. W88-08872

7. RESOURCES DATA

7A. Network Design

OPTIMAL DESIGN OF FIELD EXPERIMENTS FOR DETERMINATION OF PRODUCTION FUNCTIONS,

voor Bodemkartering, Wageningen

(Netherlands). Dept. of Soil Physics and Hydrolo-For primary bibliographic entry see Field 3F. W88-07998

DESIGN AND EVALUATION OF REGIONAL WEATHER MONITORING NETWORKS, Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.

J. B. Harcum, and J. C. Loftis.
American Society of Agricultural Engineers TAAEAJ, Vol. 30, No. 6, p 1673-1678, November-December 1987. 7 fig. 1 tab, 18 ref.

Descriptors: *Weather monitoring, *Irrigation scheduling, *Irrigation engineering, *Model studies, *Regional analysis, *Evapotranspiration, Design criteris, Design standards, Stochastic process, Spatial distribution, Networks, Colorado, Mapping.

Irrigation acheduling on a regional level is often supported by a weather monitoring network for estimating reference evapotranspiration, E sub tr. The estimation error for E sub tr can be used as a quantitative basis for designing new networks or modifying existing networks. Kalman filtering provides a convenient means for both estimating E sub tr in multistration networks and quantifying the estimation error. The procedure explicitly considers spatial and temporal correlation of the E sub tr stochastic process as well as measurement error. Application of the Kalman filtering approach to network design and evaluation is illustrated using an existing network in Colorado. The procedure is used to develop contour maps of estimation error for proposed network configurations. These maps are then used to evaluate adequacy of station density and locations. (Author's abstract)

W88-08058

TIME SERIES ANALYSIS OF WATER QUALITY DATA FROM LAKE ONTARIO: INFLICATIONS FOR THE MEASUREMENT OF WATER QUALITY IN LARGE AND SMALL LAKES,

Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs. For primary bibliographic entry see Field 2H. WRR-08103

ECOTOXICOLOGY: A FRAMEWORK FOR IN-VESTIGATIONS OF HAZARDOUS CHEMI-CALS IN THE ENVIRONMENT, Griffith Univ, Nathan (Australia). School of Australian Environmental Studies.

For primary bibliographic entry see Field 5C.

W88-08222

SPATIAL DISTRIBUTION OF PRE-WARM FRONT RAINFALL IN THE MEDITERRANE-AN AREA, Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale. For primary bibliographic entry see Field 2B. W88-08294

NITRATE IN THE INTERMEDIATE VADOSE ZONE BENEATH IRRIGATED CROPLAND, Nebraska Univ., Lincoln. Conservation Survey Div. For primary bibliographic entry see Field 5B. W88-08313

DESIGN OF LYSIMETER LEAK DETECTOR NETWORKS FOR SURFACE IMPOUND-MENTS AND LANDFILLS,

In-Situ, Inc., Laramie, WY. Computer Technology Div.
A. C. Bumb, C. R. McKee, R. B. Evans, and L. A.

Eccles. Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 102-114, Spring 1988. 14 fig. 2 tab,

Field 7—RESOURCES DATA

Group 7A-Network Design

Descriptors: *Groundwater pollution, *Waste disposal, *Path of pollutants, *Soil contamination, *Network design, Lyaimeter leak detector network, Soil moisture, Hydraulic conductivity, Waste dumps, Vadose zone, Geomorphology, Model studies, Mathematical models, Interstitial water, Land disposal, Reservoirs.

Sampling of soil pore moisture in the vadose zone underneath land disposal facilities (landfills and surface impoundments) for hazardous waste has been suggested as an 'early warning system' to detect leakage from thee facilities. Some states require vadose zone moisture sampling at such sites. Given a leak of a particular size, mathematical models can estimate the necessary moisture sample volume collection times and lysimeter spacings to guarantee detection of the leak in a homogeneous medium. Examination of 47 hazardous waste sites existing in 1984 indicated that most were located in areas with water tables too shallow to permit vadose zone detection monitoring. Sevto permit vadose zone detection monitoring. Sev-eral of the 47 sites had soils that could be described to permit vatose zone detection monitoring. Several of the 47 sites had soils that could be described as loamy sand, silt loam or silty clay. Using these three soils as examples, the process of lyaimeter leak-detector network design has been illustrated. For a particular loamy sand with a saturated hydraulic conductivity of 0.000006 cm/sec, the maximum ceramic lysimeter spacing is 15.5 feet at a depth of 30 ft to collect a moisture sample of 10 mL in one week from a l aquare ft leak. For a silt loam, maximum lysimeter spacing would be 17 ft at a depth of 15 ft. For silty clays, the maximum lysimeter spacing is 7 ft at a depth of 2 ft; maximum emplacement depth is about 9 ft. Calculations show that in some soils, suction lysimeters will not be able to collect usable moisture samples. Since soil properties vary widely and lysimeter spacing is strongly dependent on soil-moisture characteristics, appropriate soil measurements and modeling must be performed at each disposal facility to estimate lysimeter performance and to select locations for emplacement. (Author's abstract)

SIMULATION OF VAPOR TRANSPORT THROUGH THE UNSATURATED ZONE: IN-TERPRETATION OF SOIL-GAS SURVEYS, Hydrosystems, Inc., Falls Church, VA. For primary bibliographic entry see Field 5A. W88-08316

THREE-DIMENSIONAL ANALYTICAL MODEL TO AID IN SELECTING MONITOR ING LOCATIONS IN THE VADOSE ZONE. ING LOCATIONS IN THE VALOUS EXPLY, IR-Situ, Inc., Laramie, WY.
C. R. McKee, and A. C. Bumb.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p. 124-136, Spring 1988. 14 fig., 1 tab, 35 ref, 1 apper

Descriptors: *Soil contamination, *Groundwater pollution, *Path of pollutants, *Model studies, Monitoring, Flow dynamics, Infiltration, Vadose zone, Mathematical model, Computer models.

This paper describes a fast, three-dimensional, approximate analytical solution to the moisture content in the unsaturated zone. An analytical solution is available for steady-state drainage, whereas an approximate analytical solution is available for the transient case. The model will handle an arbitrary structure of fluid sources, as well as vertical and transent case. The model will handle an arbitrary distribution of fluid sources, as well as vertical and horizontal impermeable boundaries. The model may be applied to predict the incursion of fluid from accidental leakage or infiltration over large areas from unlined ponds and land treatment sites. The model is quite useful as an aid in designing The model is quite useful as an aid in designing monitoring or premonitoring programs near hazardous waste sites. Examples are presented to demonstrate the model's utility in estimating the maximum spread of a contaminant, the extent to which the fluid may spread with depth, the regions of high and low capillary pressure, and the non-linear behavior of the saturation when drainage from several sources is considered. These results are useful for the placement of monitoring locations. eful for the placement of monitoring locations and the selection of appropriate instruments, and as a tool in working with regulatory agencies to design monitoring programs. (Author's abstract)

MONITORING OF RECHARGE WATER QUALITY UNDER WOODLAND, Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). Lab. for Soil hygiene, Bilthoven (1300-1400) and Groundwater. For primary bibliographic entry see Field 5B. W88-08329

PACIFIC NORTHWEST RIVERS STUDY: AS-SESSMENT GUIDELINES, MONTANA, Montana Dept. of Fish, Wildlife and Parks, For primary bibliographic entry see Field 2E. W88-08409

COMPARISONS OF WET AND DRY DEPOSI-TION: THE FIRST YEAR OF TRIAL DRY DEP-OSITION MONITORING,

National Oceanic and Atmospheric Administra-tion, Oak Ridge, TN. Atmospheric Turbulence and

tion, Oak Kidge, I N. Atmospheric Turbulence and Diffusion Div.

B. B. Hicks, R. P. Hosker, and J. D. Womack.

IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society,

Washington, DC. 1987. p 196-203, 6 fig. 5 ref.

Descriptors: *Data acquisition, *Deposition, *Acid rain, *Sulfur, *Dry deposition, *Sampling, *Data interpretation, Comparison studies, Particulate matter, Air-earth interfaces, Filters.

A trial program has been initiated to test inferential methods for measuring dry deposition. Although present capabilities are very limited, preliminary results for sulfur deposition at a few selected locations confirm expectations that submicron particle deposition contributes far less sulfur dioxide gas exchange at the surface. Overall, average total deposition of sulfur by dry mechanisms appears to be much the same as by wet deposition in the northeast, although the short-term difference can be large (in either direction) at any particular location. (See also W88-08442) (Author's abstract)

COMPARISON OF WEEKLY AND DAILY WET DEPOSITION SAMPLING RESULTS, Environmental Monitoring and Services, Inc., Camarillo, CA. For primary bibliographic entry see Field 5B. W88-08462

MEASUREMENT OF ATMOSPHERIC GASES BY LASER ABSORPTION SPECTROMETRY, Unisearch Associates, Inc., Concord (Ontario). For primary bibliographic entry see Field 7B. W88-08466

CHEMICAL INSTRUMENTATION OF AT-MOSPHERIC WET DEPOSITION PROCESS-

Brookhaven National Lab., Upton, NY. Dept. of Applied Science. For primary bibliographic entry see Field 7B. W88-08467

DRASTIC: A STANDARDIZED SYSTEM FOR EVALUATING GROUND WATER POLLUTION POTENTIAL USING HYDROGEOLOGIC SET-

National Water Well Association, Worthington, OH L. Aller, T. Bennett, J. H. Lehr, R. J. Petty, and

L. Aller, 1. Delines, G. G. Hackett.
National Water Well Association, Dublin, Ohio.
Environmental Protection Agency Report No.
EPA-600/2-87-035, April 1987. 455 p, 45 fig, 40 tab, 485 ref, 4 append. EPA Contract No. CX-

Descriptors: *Water pollution prevention, *Path of pollutants, *Mapping, *Groundwater pollution, *Geohydrology, *Pota interpretation, Groundwater movement, DRASTIC, Computer programs, Aquifers, Solute transport, Permeability coefficient, Monitoring, Soils, Topography.

A methodology is described that will allow the pollution potential of any hydrogeologic setting to be systemstically evaluated anywhere in the United States. The system has two major portions: the designation of mappable units, termed hydrogeologic settings, and the superposition of a relative rating system called DRASTIC. Hydrogeologic settings form the basis of the system and incorporate the major hydrogeologic factors which affect and control groundwater movement including depth to water, net recharge, aquifer media, soil media, topography, impact of the vadose zone media and hydraulic conductivity of the aquifer. These factors, which form the acronym DRASTIC, are incorporated into a relative ranking scheme that uses a combination of weights and ratings to produce a numerical value called the DRASTIC Index. Hydrogeologic settings are combined with DRASTIC Indexes to create units which can be graphically displayed on a map. The DRASTIC Index. Hydrogeologic sexuage accombined with DRASTIC Indexes to create units which can be graphically displayed on a map. The application of the system to 10 hydrogeologically variable counties resulted in maps with symbols and colors which illustrate areas of groundwater contamination vulnerability. The system optimizes the use of existing data to rank areas with respect to pollution potential to help direct investigations and resource expenditures and to prioritize protection, monitoring and cleanup efforts. (Author's abstract) W88-08510

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION I.

National Water Well Association, Dublin, OH. National Water Well Association, Dublin, Ohio. May 1986. 48 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, Waste disposal, Licenses, Permits, Surveys, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual licensure and/or registration, state requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. (Lantz-PTT) W88-08516

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION II.

National Water Well Association, Dublin, OH.
National Water Well Association, Dublin, Ohio.
May 1986. 31 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, Waste disposal, Licenses, Permits, Surveys, New York, Puerto Rico, Virgin Islands.

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual licensure and/or registration, state and/or registration, state and/or registration, state and/or registration. territorial requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states and territories: New Jersey, New York, Puerto Rico, and the Virgin Islands. (Lantz-PTT)

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SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION III.
National Water Well Association, Dublin, OH.
National Water Well Association, Dublin, Ohio.
May 1986. 42 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations Waste disposal, Licenses, Permits, Surveys, Mary land, District of Columbia, Pennsylvania, Virginia West Virginia, Delaware.

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual licensure and/or registration, state and municipal requirements for goundwater monitoring wells at wate disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states and municipalities: Delaware, Washington, DC, Maryland, Pennsylvania, Virginia, West Virginia. (Lantz-PTT) W88-08518

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION IV.
National Water Well Association, Dublin, OH.
National Water Well Association, Dublin, Ohio.
May 1986. 65 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, Waste disposal, Licenses, Permits, Surveys, Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee.

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual licensure and/or registration, state requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. (Lantz-PTT) w88-08519

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION V.

National Water Well Association, Dublin, OH. National Water Well Association, Dublin, Ohio. May 1986. 48 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, Waste disposal, Licenses, Permits, Surveys, Illinois, Indiana, Michigan, Minnesota, Ohio, Wiscon-

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual licensure and/or registration, state requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. (Lantz-PTT)

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION VI. Water Well Association, Dublin, OH.

National Water Well Association, Dublin, Ohio. May 1986. 39 p, append.

Descriptors: *Groundwater quality, *Water quity control, *Monitoring wells, *Regulatio Waste disposal, Licenses, Permits, Surveys, Arks as, Louisiana, New Mexico, Oklahoma, Tex

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual flocasure and/or registration, state requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. (Lantz-PTT) W88-08521

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULA-TIONS - EPA REGION VII. National Water Well Association, Dublin, OH. National Water Well Association, Dublin, Ohio. May 1986. 34 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, Waste disposal, Licenses, Permits, Surveys, Iowa, Kansas, Missouri, Nebraska.

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual floensure and/or registration, state requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states: Iowa, Kansas, Missouri, and Nebraska. (Lantz-PTT)
W88-08522

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - FPA REGION VIII.
National Water Well Association, Dublin, OH.
National Water Well Association, Dublin, Ohio.
May 1986. 50 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, waste disposal, Licenses, Permits, Surveys, Colorado, Montana, North Dakota, South Dakota,

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the ground-water industry concerning maintenance of ground-water quality. Monitoring well installation, individual licensure and/or registration, state requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. (Lantz-PITT)
W88-08523

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION IX.
National Water Well Association, Dublin, OH.
National Water Well Association, Dublin, Ohio.
May 1986. 46 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, Waste disposal, Licenses, Permits, Surveys, American Samoa, Arizona, California, Guam, Hawaii,

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual licensure and/or registration, state and terriorial requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states and territories: American Samoa, Arizona, California, Guam, Hawaii, and Nevada. (Lantz-PTT)

SUMMARY OF STATE GROUND WATER QUALITY MONITORING WELL REGULATIONS - EPA REGION X.

National Water Well Association, Dublin, OH. National Water Well Association, Dublin, Ohio. May 1986. 32 p, append.

Descriptors: *Groundwater quality, *Water quality control, *Monitoring wells, *Regulations, Waste disposal, Licenses, Permits, Surveys, Alaska, Idaho, Oregon, Washington.

The National Water Well Association, in its liaison function between industry and government, conducted a nationwide survey that of federal and state legislation and regulations impacting the groundwater industry concerning maintenance of groundwater quality. Monitoring well installation, individual licensure and/or registration, state requirements for goundwater monitoring wells at waste disposal sites, construction standards for monitoring wells, and record keeping, permits and notices for well construction, are discussed in this report for the following states: Alaska, Idaho, Oregon, and Washington. (Lantz-PTT)

EFFECTS OF STORM AND GAGE LOCATION ON TRIBUTARY LOAD ESTIMATE,

Ohio State Univ., Columbus. Dept. of Civil Engi-

K. W. Bedford, and D. J. Mark. Journal of Environmental Engineering JOEDDU, Vol.114, No. 2, p 352-367, April 1988. 7 fig. 4 tab, 22 ref. NOAA Sea Grant NA84AA-D-0079 R/ EM-4.

Descriptors: *Nonpoint pollution sources, *Path of pollutants, *Pollution load, *Water pollution, *Lakes, *Great Lakes, *Gages, *Data collection, *Solute transport, Lake Erie, Chlorides, Model studies, Sampling, Spatial distribution.

Monthly and annual pollution loads delivered to Great Lakes receiving waters are made from data often collected far upstream of the mixing zone at the tributary receiving water confluence. The reliability of confluence loading estimates as determined from these upstream gages has not been established. Using data collected during 1981 in Sandusky Bay-Lake Erie, a combined hydrodynamic and chloride transport model is used to synthesize the load at the confluence. This load is compared to that obtained with data collected during the same time period from the U.S. Geological Survey (USGS) Fremont, Ohio gage which is 29 km upstream of the confluence. The load at the confluence was 2.5 times greater than that estimated with the USGS data. The difference is, for the conservative substance sampled here, attributed to conservative substance sampled here, attributed to a timing or phasing error. However, the implica-tion for nonconservative substance load estimates is that this difference would be more severe from that resulting from a timing problem. (Author's abstract) W88-08574

TEMPORAL SAMPLING AND DISCHARGE ASYMMETRY IN SALT MARSH CREEKS, Manchester Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 2L.

Field 7—RESOURCES DATA

Group 7A-Network Design

STUDIES OF THE SAMPLING TIME OF THE EFFLUENT OF THE MUNICIPAL SEWAGE TREATMENT PLANT TO EVALUATE THE EFFECTS ON THE GROWTH OF PORPHYRA YEZOENSIS, (IN JAPANESE), Tokyo Univ. of Fisheries (Japan). For primary bibliographic entry see Field 5E. W88-08890

COMPUTER UTILIZATION IN DISTRIBU-TION (L'UTILISATION DES ORDINATEURS DANS LA DISTRIBUTION),

Keuringsinstituut voor Waterleidingartikelen, Rijs-wijk (Netherlands). For primary bibliographic entry see Field 5F. W8E-08920

7B. Data Acquisition

NONCONTACT LASER SYSTEM FOR MEAS-URING SOIL SURFACE TOPOGRAPHY. National Soil Erosion Lab., West Lafayette, IN. C. Huang, I. White, E. G. Thwaite, and A.

Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 350-355, March-April 1988. 11 fig, 10 ref.

Descriptors: *Soil surface topography, *Lasers, *Measuring instruments, Performance evaluation, Hydrology, Rainfall intensity, Runoff, Erosion, Retention, Rainfall impact.

Soil surface topography profoundly influences runoff hydrodynamics, soil erosion, and surface retention of water. Here is described an optical retention of water. Here is described an optical noncontact system for measuring soil surface to-pography. Soil elevation is measured by projecting a laser beam onto the surface and detecting the position of the interception point. The optical axis of the detection system is oriented at a small angle to the incident beam. A low-power HeNe (Helium-Neon) laser is used as the laser source, a phototo the incident beam. A low-power HeNe (Helium-Neon) laser is used as the laser source, a photodiode array is used as the laser image detector and an ordinary 35-mm single lens rel'ex camera provides the optical system to focus the laser image onto the diode array. A wide spectrum of measurement ranges (R) and resolutions are selectable, from 1 mm to 1 m. These are determined by the laser-camera distance and angle, the focal length of the lens, and the sensing length of the diode array and the number of elements (N) contained in the array. The resolution of the system is approximately R/2N. We show for the system used here that this resolution is approximately 0.2%. In the configuration selected, elevation changes of 0.16 mm could be detected over a surface elevation range of 37 mm. The sampling rate of the system is 1000 Hz, which permits soil surfaces to be measured at 1-mm spacing. Measurements of individual rain-drop impacts on the soil and of soil surfaces before and after rain show the versatility of the laser surface profiler, which has applications in studies of erosion processes, surface storage and soil trafficability. (Author's abstract)

FEASIBILITY OF USING SEQUENTIAL EX-TRACTION TECHNIQUES FOR ARSENIC AND SELENIUM IN SOILS AND SEDIMENTS, Geological Survey, Menlo Park, CA. For primary bibliographic entry see Field 5A. W8E-07994

DETERMINATION OF INORGANIC ARSENIC (III) AND ARSENIC (III PLUS V) USING AUTOMATED HYDRIDE-GENERATION ATOMIC-ABSORPTION SPECTROMETRY, Agricultural Research Service, Riverside, CA. Sa-linity Lab. For primary bibliographic entry see Field 5A. W88-08002

RAPID DETERMINATION OF MAGNESIUM AND CALCIUM HARDNESS IN WATER BY ION CHROMATOGRAPHY,

For primary bibliographic entry see Field 2K. W88-08021

ANALYSIS OF RAIN WATER BY DIFFEREN-TIAL-PULSE STRIPPING VOLTAMMETRY IN NITRIC ACID MEDIUM, Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

For primary bibliographic entry see Field 5A. W88-08022

SIMPLE TECHNIQUE FOR ESTIMATING AB-SORPTION AND SCATTERING COEFFI-

CIENTS,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, R. Roop, and M. O. Perkins.
Water Resources Bulletin WARBAQ, Vol. 24, No.
2, p 397-404, April 1988. 4 fig. 2 tab, 23 ref.

Descriptors: *Scattering coefficients, *Absorption, *Optical properties, *Light quality, *Analytical methods, Model studies, Limnology, Prediction, Lakes, Estimating, Transparency, Light penetration, Secchi disks.

Results from five different test systems, which include a wide range of optical conditions, indicate credible estimates of the values of the absorption and scattering coefficients can be calculated from paired measurements of Secohi disc transparency and the diffuse attenuation coefficient. The diagnostic utility of the estimates in identifying components and processes that regulate light penetration is demonstrated for three different cases. The simple estimation technique is valuable in the analysis of existing data bases that lack comprehensive optical information to develop and evaluate alternate models for light penetration and to establish the experimental needs of future field programs to support lake management efforts. (Author's abstract) stract) W88-08047

MODEL PREDICTIONS OF WATERSHED EROSION COMPONENTS,
Oak Ridge National Lab., TN. Engineering Phys-For primary bibliographic entry see Field 2J. W88-08049 ics Section

IRRIGATION WATER DELIVERY SYSTEM OPERATION VIA AGGREGATE STATE DYNAMIC PROGRAMMING, Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 3F.
W88-08051

SEPARABLE LINEAR ALGORITHM FOR HY-DROPOWER OPTIMIZATION,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering. For primary bibliographic entry see Field 8C. W88-0805.

ESTIMATION OF ATMOSPHERIC LIQUID-WATER AMOUNT BY NIMBUS SMMR DATA: A NEW METHOD AND ITS APPLICATION TO THE WESTERN NORTH-PACIFIC REGION, Nagoya Univ. (Japan). Water Research Inst. T. Takeda, and G. Liu. Journal of the Meteorological Society of Japan JMSJAU, Vol. 65, No. 6, p 931-947, December 1987. 16 fig, 16 ref.

Descriptors: *Remote sensing, *Microwave radiometry, *Atmospheric water, *Clouds, *Cloud liquid water, *Precipitation, *Radiometry, Cloud physics, Estimating, Satellite technology, Microwaves, Climatology, Cloud cover, Water vapor, Rainfall, Pacific Ocean, Tropic zone, Subtropic von. Temperature vone.

There is an urgent need to estimate liquid water amount in extensive clouds, in order to investigate the cloud water to rainwater conversion process in them, their radiative properties, and their climato-

logical features. A new method of estimating verti-cally-integrated liquid water amount and identify-ing precipitating clouds is presented; it use Nimbus 7 satellite scanning multichannel micro-wave radiometer data and is based on calculations of microwave radiative transfer. Using the climatoof microwave radiative transfer. Using the climato-logical values of atmospheric water-vapor amount and sea surface temperature, the primary values of integrated liquid water amount were determined from microwave radiative data at 18 GHz and 37 GHz on the assumption that clouds are composed of water drops so small that the scattering in microwave bands can be completely neglected. By comparing 18 and 37 GHz data for different types of clouds, it was concluded that the best estimated value is that at 37 GHz when liquid water amount is small, and a linear combination of data from the two frequencies when the amount is large. Com-parison with other methods showed that the new method gives reasonable estimates for both precipiparison with other methods showed that the new method gives reasonable estimates for both precipitating and non-precipitating clouds. Furthermore, comparison of the difference between 18 and 37 GHz data and hourly rainfall suggests that if the difference is larger than 10 mg/cc the clouds may be supposed to be precipitating. The method was applied to clouds in the western North Pacific region in February 1980. Average integrated liquid water amount was about 20 mg/cc for low-level clouds and 36 mg/cc for high-top clouds; when liquid water amount was larger than 100 mg/cc, clouds were identified to be precipitating without regard to type. In tropical and subtropical zones, integrated liquid water amount was roughly proportional to cloud amount but much less for the same cloud amount at middle latitudes. (Shidler-PTT) PTT) W88-08123

BENCH-SCALE EVALUATION OF COAGULANTS FOR LOW TURBIDITY WATER, Colorado Dept. of Health, Denver. For primary bibliographic entry see Field 5F. W88-08130

APPLICATION OF DIALYSIS BAGS FOR MONITORING THE GROUNDWATER QUALITY DOWNSTREAM OF A LANDFILL, Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer For primary bibliographic entry see Field 5A. W88-08165 Hydrologie.

VOLTAMMETRIC DETERMINATION OF MERCURY IN A SEWAGE SLUDGE SAMPLE, Fachhochschule Aachen (Germany, F.R.). M. Kolb, M. Jochle, and J. Schafer. Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 20, No. 6, p 210-211, December 1987. 1 fig, 4 ref.

Descriptors: *Sludge, *Mercury, *Heavy metals, *Chemical analysis, Aqua regia, Anodic stripping voltammeter, Quantitative analysis.

Anodic stripping voltammetric (DPASV) was studied for determination of mercury in sewage sludge after digestion by aqua regia. The quantitative analysis of the mercury peak is disturbed by an organic substance which is not completely digested by aqua regia. By taking certain voltammetric parameters into consideration and using an accurate background current (without the Hg-peak) it is possible to determine mercury with sufficient accuracy. (Author's abstract)
W88-08167

PRECISE PH-MEASUREMENT IN DRINKING WATER,

Wissenschaftlich-Technische G.m.b.H., Weilheim (Germany, F.R.).

Zeitschrift fuer Wasser - und Abwasser Forschung ZWABAQ, Vol. 21, No. 1, p 1-6, February 1988. 3

Descriptors: *Water analysis, *Drinking water, *Hydrogen ion concentration, *Chemical analysis.

Data Acquisition—Group 7B

Measurements of pH in drinking water can be highly accurate, yet estimations can result in errors. The cause of multiple errors was studied, and indications of their magnitude obtained. Procedures and a modern microprocessor-supported pH-measuring technique were order to eliminate the dominating measurement uncertainties. (Author's abstract) abstract) W88-08169

DURABLE AND TRANSPORTABLE LIMNE-TIC ENCLOSURE SYSTEM SUITABLE FOR WIND-EXPOSED LAKES,

ch Inst., Oosterzee (Netherlands). Tieukemeer Lab.

B. VanderWerf, J. Schrotenboer, A. F. Richter, J.

B. Vander Wert, J. Schrotenboer, A. F. Richter, J. R. Moed, and H. L. Hoogweld. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 44, No. 9, p 1649-1652, September 1987. 3 fig., 3 tab, 8 ref.

Descriptors: *Equipment, *Field tests, *PVC, *Polyvinylchloride, *Phytoplankton, *Enclosures, *Lake enclosures, Lakes, Wind-Echnology, The Netherlands, Wind-exposed lakes, Leaching, Aquatic enclosure systems, Limetic enclosure systems, Editorial Control of the Control of the

A 2-m-wide transportable enclosure system suitable for cold, windy lakes is described. Incubation of these enclosures in the shallow (mean depth = 1.5 m) Lake Tjeukemeer, The Netherlands, has shown that its construction resists wind speeds of 14-20 miles per second and temperatures below 5 degrees Centigrade. Potentially lethal concentrations of at least five toxic chemicals necessitate realiminary leaching in lake water of the polyvinpreliminary leaching in lake water of the polyvin-ylchloride material used in bag construction. Phy-toplankton inside and outside the enclosures be-haved similarly 3 days and 3 weeks into incubation. (Author's abstract) W88-08261

TIME-SAVING FILTRATION SYSTEM FOR NUTRIENT ANALYSIS, Wisconsin State Lab. of Hygiene, Madison. G. T. Bowman, B. A. Schuknecht, J. E. Wilken,

G. T. Bowman, B. A. Schukhelm, J. B. Hallen, and W. C. Sonzogni.
Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 44, No. 11, p 2018-2021, November 1987. 1 fig. 2 tab, 7 ref.

Descriptors: *Sample preparation, *Laboratory equipment, *Nutrients, *Chemical analysis, *Filtration, *Nutrient analysis, *Membrane filtration, Filtration techniques, USA.

Conventional membrane filtration to separate particulate material from water samples, such as the analysis of dissolved nitrogen and phosphorous, is time consuming and subject to contamination. To minimize this problem, a device is presented that allows filtration of up to 80 samples per hour without introducing contamination or affecting the sample integrity. The device requires only partial dismantling and minimal cleaning with dilute hydrochloric acid between samples. Validation tests show that the device does not alter dissolved constituents in filtered samples. Unlike conventional membrane filtering apparatus, a cumbersome vacuum flask is not required. The system is compact and easily adapted to mobile and shipboard laboratories. (Author's abstract)

TIME OF ONSET OF FULL THERMAL STRATIFICATION IN LAKE ONTARIO IN RELATION TO LAKE TEMPERATURE IN WINTER,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2H.
W88-08289

MONITORING THE VADOSE ZONE IN FRAC-TURED TUFF, Earth Technology Corp., Long Beach, CA. P. Montazer, E. P. Weeks, F. Thamir, D. Hammermeister, and S. N. Yard.

Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 72-88, Spring 1988. 22 fig, 2 tab, 24

Descriptors: *Groundwater movement, *Monitoring, *Vadose zone, *Waste disposal, *Hydraulic conductivity, *Borehole geophysics, Hydrology, Aeration zone, Radioactive wastes, Nevada, Performance evaluation, Tuff, Rock properties, Atmospheric parastructure.

Unsaturated tuff beneath Yucca Mountain, Nevada, is being evaluated by the U.S. Department of Energy as a host rock for a potential repository for high-level radioactive waste. As part of the Nevada Nuclear Waste Storage Investigations Project of the U.S. Department of Energy, the U.S. Geological Survey has been conducting hydrologic, geologic and geophysical investigations at Yucca Mountain and the surrounding region. Hydrologic investigations of the unsature of the programment of t nyurologic, geologic and geophysican investiga-tions at Yucca Mountain and the surrounding region. Hydrologic investigations of the unsaturat-ed zone at this site began in 1982. After more than two years of monitoring, the majority of the instru-ments were still functioning and producing reason-able data. A slow recovery from the disturbed state to natural conditions was detected during the first 90 days of monitoring; this recovery was probably a result of the large diameter of the borehole (44.5 cm). Preliminary results indicated that suction pressures for the welded units ranged from -0.2 to -1.5 mega pascals. Some agreement existed between data from psychorometers and from heat-dissipation probes, except where silica flour was not in equilibrium with the formation. Water fluxes estimated in the matrix of the reposi-tory host-rock unit range from 0.1 to 0.5 mm per Water fluxes estimated in the matrix of the reposi-tory host-rock unit range from 0.1 to 0.5 mm per year using matric-potential distribution, and from -0.025 to -0.05 mm per year using geothermal gradi-ent. Response to short-term barometric fluctua-tions were detected to a maximum depth of about 91 m in the borehole. Below this depth, only long-term barometric fluctuations were detectable. Equivalent effective hydraulic conductivity, esti-mated from air permeability, ranged from 0.2 to 0.6 m per day. (Author's abstract)

REPRESENTATIVENESS OF PORE WATER SAMPLES COLLECTED FROM THE UNSATURATED ZONE USING PRESSURE-VACUUM LYSIMETERS,

logical Survey, Denver, CO. Water Resources

C. A. Peters, and R. W. Healy. Ground Water Monitoring Review GWMRDU, Vol. 8, No. 2, p 96-101, Spring 1988. 1 fig, 7 tab, 21

Descriptors: *Pore water, *Sampling, *Aeration zone, *Lysimeters, Chemical properties, Pressure vacuum, Trace metals, Water analysis, Hydrogen

Pressure-vacuum lysimeters are an inexpensive means of collecting numerous water samples from the same location in the unsaturated zone over a the same location in the unsaturated zone over a period of time. However, prior studies have indicated that the chemistry of water samples may be altered by the collection technique, creating concern about the representativeness of the pore water samples obtained. A study conducted using soil water pressure-vacuum lysimeters in outwash and glacial till deposits demonstrates that from non-dilute-solution samples the effect on pH of sampling with lysimeters is minimal, and that measured major cation and anion concentrations are representative of the natural pore water; trace-metal sentative of the natural pore water; trace-metal concentrations can be significantly altered by collection procedures at low concentrations. (Author's abstract) W88-08314

HUNTER REGION (AUSTRALIA) ACID RAIN

PROJECT, Newcastle Univ. (Australia). Dept. of Geography. For primary bibliographic entry see Field 5B. W88-08320

THUNDERSTORM-PRODUCING TERRAIN FEATURES.

Air Force Geophysics Lab., Hansoom AFB, MA. For primary bibliographic entry see Field 2B. W88-08321

PROPOSED TROPICAL RAINFALL MEASUR-ING MISSION (TRMM) SATELLITE,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. J. Simpson, R. F. Adler, and G. R. North. Bulletin of the American Meteorological Society BAMIAT, Vol 69, No. 3, p 278-295, March 1988. 18 fig, 10 tab, 72 ref.

Descriptors: Remote sensing, "Rainfall, "Precipita-tion, "Climatology, "Satellite technology, "Tropi-cal regions, Model studies, Algorithms, Radio-metry, Marine climate, Radar.

The Tropical Rainfall Measuring Mission satellite is planned for an operational duration of at least three years, beginning in the mid-1990's. The main scientific goals for it are to determine the distribution and variability of precipitation and latent-heat release on a monthly average over areas of about 100 000 sq. km, for use in improving short-term climate models, global circulation models and in understanding the hydrological cycle, particularly as it is affected by tropical oceanic rainfall and its variability. The Tropical Rainfall Measuring Mission satellite's instrumentation will consist of the first quantitative spaceborne weather radar, a multichannel passive microwave radiometer and an Advanced Very High Resolution Radiometer. The satellite's orbit will be low altitude (about 320 km) for high resolution and low inclination (30 to 35 degrees) in order to visit each sampling area in the topics about twice daily at a different hour of the topics about twice daily at a different hour of the day. A strong validation effort is planned with day. A strong validation effort is planned with several key ground sites to be instrumented with several key ground sites to be instrumented with calibrated multiparameter rain radars. Mission goals and science issues are summarized. Research progress on rain retrieval algorithms is described. Radar and passive microwave algorithms are dis-cussed and the use of radiative models in conjunc-tion with cloud dynamical-microphysical models is emphasized. Algorithms are being and will contin-ue to be tested and improved using microwave instruments on high-altitude aircraft overflying precipitating convective systems, located in the range of well-calibrated radars. (Author's abstract) W88.08325.

INTERRELATION OF HYDRAULIC AND ELECTRICAL CONDUCTIVITIES, STREAM-ING POTENTIAL, AND SALT FILTRATION DURING THE FLOW OF CHLORIDE BRINES THROUGH A SMECTITE LAYER AT ELEVAT-ED PRESSURES,

Hilinois Univ., Urbana. Dept. of Geology. For primary bibliographic entry see Field 5B. W88-08326

INTEGRATED APPROACH TO AQUIFER DE-LINEATION IN HARD ROCK TERRAINS: A CASE STUDY FROM THE BANDA DISTRICT, INDIA,

Roorkee Univ. (India). School of Hydrology. For primary bibliographic entry see Field 2F. W88-08334

STATISTICAL INTERCOMPARISON OF EVI ESTIMATORS BY MONTE CARLO SIMULA-TION.

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering. For primary bibliographic entry see Field 2E.

PRIMITIVE PSEUDO WAVE EQUATION FOR-MULATION FOR SOLVING THE HARMONIC SHALLOW WATER EQUATIONS,

Texas A and M Univ., College Station. Ocean Engineering Program. For primary bibliographic entry see Field 8B. W88-08352

Field 7—RESOURCES DATA

Group 7B-Data Acquisition

THREE INSTRUMENTS USED IN RAINFALL-RUNOFF SIMULATION EXPERIMENTS, Academia Sinica, Beijing (China). Inst. of Geogra-

phy.
W. Kai, and L. Changming.
Hydrological Processes HYPRE3, Vol. 2, No. 2, p
151-154, April 1988. 4 fig, 3 ref.

Descriptors: *Rainfall simulators, *Rainfall-runoff relationships, *Soil moisture meters. *Resistance flume, *Hydrological data collections, Channel flow, Runoff, Soil water, Watersheds, Model studies, Laboratory equips

The Runoff Formation Laboratory of the Institute of Geography, Academia Sinica, is one of two hydrological simulation laboratories in China. Facilities include rainfall simulation apparatus, a steel cilities include rainfall simulation apparatus, a steel watershed model tank and a variety of measuring equipment employed in experimental systems for investigating natural rainfall-runoff processes and processes of runoff formation, including hillslope runoff, channel flow and soil-water movement, and for providing experimental data for use in the development of mathematical watershed models. A box rainfall simulator, a resistance flume for runoff measurement and a semiconductor multipoint soil moisture sensor, used in the rainfall-runoff experiments, are described. (Author's abstract) W88-08:56

SIMULTANEOUS COLLECTION OF PARTI-CLES AND ACIDIC GASES FOR TRACING EMISSIONS FROM COAL-FIRED POWER

PLANTS, Maryland Univ., College Park. Dept. of Chemis-

try.
M. E. Kitto, and D. L. Anderson.
IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society, Washington, DC. 1987. p 84-92, 4 fig, 2 tab, 13 ref.

Descriptors: *Air pollution, *Particulate matter, *Path of pollutants, *Volatile gases, *Acids, *Fiiters, *Chemical analysis, *Heavy metals, *Powerplants, On-site data collections, Sampling, Coal.

Particulate and gaseous atmospheric components have been sampled using a multiple-filter system. A Teflon filter for particle collection preceded four (7)LiOH/glycerol treated Whatman-41 filters in a stacked filter arrangement. Up to fifty elements were detected on the particulate filter, while ten elements (B, N, S, Cl, As, Se, Sb, Br, I and Hg) were observed on the base-treated filters using the same of the s elements (B, N, S, Cl, As, Se, Sb, Br, I and Hg) were observed on the base-treated filters using the combined techniques of PGAA, INAA and IC. The base-treated filters proved to be very efficient collectors of the acidic gas-phase species, but apparently allow some elemental and organic species to pass through as shown by studies with activated charcoal-impregnated filters. Application of observed concentrations of atmospheric particles and acidic gases are compared to the results predicted by a hybrid receptor model. (See also W88-08442) (Author's abstract)

W88-08449

CHARACTERIZATION OF A FACILITY TO SIMULATE IN-CLOUD CHEMICAL TRANS-

Nevada Univ. System, Reno. Energy and Environ-

mental Engineering Center.

A. W. Gertler, N. F. Robinson, and D. F. Miller.

IN: The Chemistry of Acid Rain: Sources of Acid Rain: mospheric Processes. American Chemical Society, Washington, DC. 1987. p 183-194, 2 fig, 3 tab, 13

Descriptors: *Simulation, *Chemical reactions, *Laboratory equipment, *Acid rain, *Cloud physics, *Model testing, *Atmospheric water, Variability, Computers, Sulfur dioxide.

Laboratory simulations of aqueous-phase chemical Laboratory simulations of aqueous-phase chemical systems are necessary to 1) verify reaction mechanisms and 2) assign a value and an uncertainty to transformation rates. A dynamic cloud chemistry simulation chamber has been characterized to obtain these rates and their uncertainties. Initial experimental results exhibited large uncertainties, with a 26% variability in cloud liquid water as the

major contributor to measurement uncertainty. Uncertainties in transformation rates were as high as factor of ten. Standard operating procedures and as factor of ten. Standard operating procedures and computer control of the simulation chamber decreased the variability in the observed liquid water content, experiment duration and final temperature from +/- 0.5 to +/- 0.10 g/cu m, +/- 180 to +/- 5.3 s and +/- 1.73 to +/- 0.27 C respectively. The consequences of this improved control over the experimental variables with respect to cloud chemistry were tested for the aqueous transformation of SO2 using a cloud-physics and chemistry model of this system. These results were compared to measurements made prior to the institution of standard operating procedures and computer constandard operating procedures and computer constandard operating procedures and computer conto the assurements made prior to the institution of standard operating procedures and computer control to quantify the reduction in reaction rate uncertainty resulting from those controls. (See also W88-0842) (Author's abstract)

COMPARISONS OF WET AND DRY DEPOSITION: THE FIRST YEAR OF TRIAL DRY DEPOSITION MONITORING,
National Oceanic and Atmospheric Administration, Oak Ridge, TN. Atmospheric Turbulence and Diffusion Div. For primary bibliographic entry see Field 7A. W88-08458

MEASUREMENT OF ATMOSPHERIC GASES MEASUREMENT OF AIMUSPHERIC GASES
BY LASER ABSORPTION SPECTROMETRY,
Unisearch Associates, Inc., Concord (Ontario).
H. I. Schiff, G. W. Harris, and G. I. Mackay.
IN: The Chemistry of Acid Rain: Sources of Atmospheric Processes. American Chemical Society,
Washington, DC. 1987. p 274-288, 11 fig. 6 ref.

Descriptors: *Spectroscopy, *Laser absorption spectrometry, *Trace levels, *Gases, *Air pollution, *Data acquisition, Precision, Computers, Nitrogen compounds, Ammonia, Hydrogen peroxide, Formaldehyde.

The advantages of Tunable Diode Laser Absorption Spectrometry (TDLAS) for measuring trace atmospheric gases are universality, positive identification, good sensitivity and rapid response time. An instrument is described which can measure two gases simultaneously under automatic computer control with detection limits better than 100 parts per trillion and with response times better than 5 minutes. Procedures have been established for the measurement of NO, NO2, HNO3, NH3, H2O2 and HCHO. These species have been measured under a variety of conditions in smog chambers and in ambient air from mobile laboratories and from aircraft. (See also W88-08442) (Author's abstract) stract) W88-08466

CHEMICAL INSTRUMENTATION OF AT-MOSPHERIC WET DEPOSITION PROCESS-

ES, Brookhaven National Lab., Upton, NY. Dept. of Applied Science. R. L. Tanner. IN: The Chemistry of Acid Rain: Sources of At-

mospheric Processes. American Chemical Society, Washington, DC. 1987. p 289-302, 5 fig, 1 tab, 31

Descriptors: "Acid rain, "Deposition, "Rainfall, "Data acquisition, "Measuring instruments, "Trace levels, "Data interpretation, Path of pollutants, Gases, Nitrogen oxides, Sulfates, Organic compounds, Aerosols

Field studies of wet deposition processes require the differentiation and determination of many reac-tive species at trace levels in clear-air gaseous and aerosol phases and in air containing clouds and precipitation. These studies have placed extremely precipitation. These studies have placed extremely rigorous requirements on existing analytical techniques and, in several instances, required development of new approaches to sampling and determination of critical species. Measurement techniques for nitrogen oxides and oxyacids, SO2 and aerosol sulfate species, oxidant species including hydrogen peroxide and PAN, and various organic species in the gas, aerosol and, where appropriate, aqueous

phases from airborne platforms are reviewed. Emphasis is on recent developments in real-time and short-term integrated measurements which permit the differentiation of below-cloud, within-cloud (interstitial), and aqueous phase species concentrations of oxidants, and of sulfuric and nitric acids and their precursors. Recent developments in measurement techniques for nitrogen oxides and gaseous H2O2 applicable to airborne sampling are highlighted. (See also W88-08442) (Author's abstract) W88-08467

EUROPE FROM SPACE.

EUROPE FROM SPACE,
European Space Agency, Paris (France).
Available from the National Technical Information
Service, Springfield, VA. 22161, as N87-28115.
Price codes: A14 in paper copy, A01 in microfiche.
Proceedings of an ESA/EARSeL Symposium
held in Conjunction with EARSeL's General Assembly at the Technical University of Denmark,
Lyngby, June 25-27, 1986. Report No. SP-258,
December 1986. 310 p.

Descriptors: *Remote sensing, *Data acquisition, *Satellite technology, Cartography, Costs, Economic aspects, Mapping, Resources management.

This proceedings presents papers on the following topics: (1) cartography and geo-information; (2) management of non-renewable resources; (3) inventory and monitoring of renewable resources;
(4) environmental dangers, difficulties and degradation; and (5) economics of satellite remote sensing: costs and benefits. (See W88-08471 thru W88-08481) (Lantz-PTT)

METEOROLOGICAL MONITORING WITH METEOSAT,

European Space (Germany, F.R.). ce Operations Centre, Darmstadt

J. Schmetz, and O. Turpeinen.

IN: Europe from Space. Proceedings of an ESA/ EARSeL Symposium held in Conjunction with EARSeL's General Assembly at the Technical University of Denmark, Lyngby, June 25-27, 1986. Report No. SP-258, December 1986. p 43-48, 5 fig. 8 ref.

Descriptors: *Meteorology, *Monitoring, *Data acquisition, *Precipitation, Remote sensing, European Space Operations Center, Image analysis, Satellite technology, METEOSAT.

The meteorological monitoring with METEOSAT at the European Space Operations Center (ESOC) includes the near-real time derivation of atmosincludes the near-real time derivation of atmosphere and surface parameters. The software system to extract quantitative meteorological information from the image data is in operation successfully for some years. This note describes the ongoing work at ESOC to improve and extend the meteorological monitoring. In particular, improvements to the extraction of cloud-track winds and a new atmospheric correction scheme are discussed. A precipitation index which has been introduced as a new product is described. (See also W88-08470) (Author's abstract)
W88-08471 W88-08471

MONITORING OF SNOW COVER FROM SAT-

Helsinki Univ. of Technology, Espoo (Finland).

M. Hallikainen, P. Jolma, M. Tiuri, and R. Kuittinen.

Nutturen.

IN: Europe from Space. Proceedings of an ESA/
EARSeL Symposium held in Conjunction with
EARSeL's General Assembly at the Technical
University of Denmark, Lyngby, June 25-27, 1986.
Report No. SP-258, December 1986. p 49-52, 4 fig.

Descriptors: *Data acquisition, *Snow cover, *Satellite technology, *Radiometers, *Remote sensing, Monitoring, Data interpretation, Optical properties, Rainfall equivalents.

Data Acquisition—Group 7B

Monitoring of snow cover using spaceborne micro-wave radiometers is examined. Discrimination of snow-covered terrain (dry/wet snow) from snow-free terrain is discussed. Retrieval of the water equivalent of snow cover is tested on the decrease of the brightness temperature with increasing snow depth, which is due to volume scattering of micro-wave emissions by dry snow particles. For wet snow conditions, the brightness temperature is practically independent of snow depth. Retrieval accuracy is affected by short-term and annual vari-ations in the properties of the topmost snow layers and by land-cover categories. (See also W88-08470) (Author's abstract) W88-08472

USE OF NOAA-AVHRR DATA IN THE LOWER RHONE VALLEY FRANCE, Institut National de la Recherche Agronomique, Montfavet (France). Station of Bioclimatologie. J. P. Lagouarde, S. Clinet, S. Gandia, S. Roy, and A. Vidal.

J. P. Lagouarde, S. Cinnet, S. Candua, S. Roy, and A. Vidal. IN: Europe from Space. Proceedings of an ESA/ EARSeL's General Assembly at the Technical University of Denmark, Lyngby, June 25-27, 1986. Report No. SP-258, December 1986. p 69-74, 11 fig, 17 ref.

Descriptors: *Rhone River, *France, *Data acquisition, *Vegetation, *Remote sensing, Aerosols, Normalized Vegetation Index, Evapotranspiration, Plant water, Soil water, Monitoring, Temperature.

Plant water, Soil water, Monitoring, Temperature.

NOAA-AVHRR derived normalized vegetation index (NDVI) and surface temperature are analyzed in the lower Rhone Valley. The study of temporal evolution of NDVI during 1983 and 1984 on different types of vegetation both at a regional (50-100 sq km) and then more local scale (I to 4 pixels), shows the potential of these data for vegetation monitoring. The atmosphere effects may cause large fluctuations on NDVI values; a correction is proposed for water while the effects of aerosols is also analyzed. A calibration against ground measurements is presented to deal with temperature; satellite data appear underestimated by about 3 to 4 C. Use of NOAA data in combination with an agrometeorological model is then described and examples of applications are given, such as: estimation of regional evaportranspiration, determination of useful water soil reserve, and irrigation supplied to crops. (See also W88-08470) (Author's abstract)

W88-08473

DETECTION OF SOIL DRAINAGE IN 'PAYS DE HERVE' - BELGIUM - ON LANDSAT MSS

Ghent Rijksuniversiteit (Belgium). Lab. voor Re-gionale Geographie en Landschapskunde. For primary bibliographic entry see Field 7C.

REMOTE SENSING INVESTIGATION OF THE OIL SPILL IN THE STRAIT OF MESSINA,

TIALY,
Catania Univ. (Italy). Dept. of Engineering.
For primary bibliographic entry see Field 5B.
W88-08475

USE OF AVHRR CHANNEL-3 DATA FOR EN-VIRONMENTAL STUDIES, Dundee Univ. (Scotland). Physics Lab. A. P. Crackbell, and M. C. Dobson. IN: Europe from Space. Proceedings of an ESA/ EARSeL Symposium held in Conjunction with EARSeL's General Assembly at the Technical University of Denmark, Lyngby, June 25-27, 1986. Report No. SP-258, December 1986. p 137-144, 5 fig. 1 tab. 8 ref. fig. 1 tab. 8 ref.

Descriptors: *Environmental impact statements, *AVHRR, *Data acquisition, *Satellite technology, *Remote sensing, *Clouds, Denmark, Monitoring, Temperature, Agriculture, Path of pollutants, Algorithms, Fires.

Channel-3 of the AVHRR is a source of data that has been very much neglected. In this paper, some

of the potential uses of data from this channel are discussed, and results presented. In meteorological work channel-3 data enable more discrimination to be achieved between different types of clouds than can be achieved with data from other channels. Channel-3 data can also be used, from night-time passes, in multichannel algorithms for calculating sea surface temperatures. The use of channel-3 data in monitoring gas flares at oil exploration and production platforms in the North Sea, and in monitoring agricultural straw burning, have been successfully studied. Some new results for Denmark are presented. (See also W88-08470) (Author's abstract)

SATELLITE REMOTE SENSING FOR WATER RESOURCES MANAGEMENT: SOME ENGINEERING AND ECONOMIC ASPECTS, Ruhr Univ., Bochum (Germany, F.R.). G. A. Schultz.

G. A. Schutz.
IN: Europe from Space. Proceedings of an ESA/
EARSeL Symposium held in Conjunction with
EARSeL'S General Assembly at the Technical
University of Denmark, Lyngby, June 25-27, 1986.
Report No. SP-258, December 1986. p 171-177, 6
fig. 1 tab, 12 ref.

Descriptors: *Water resources management, *Remote sensing, *Economic aspects, *Hydrologic models, Data acquisition, Satellite technology, River flow, Model studies, Runoff, Rainfall-rundrelationships, Water management, Catchment

Two applications of remote sensing (RS) techniques to water management problems are briefly demonstrated: (1) By the use of satellite imagery it is possible to identify changes of land use in a river catchment. If this information is entered into mathematical rainfall-runoff models, it is possible to show the effect of land use change on flood and show the effect of land use change on flood and low flow conditions quantitatively; (2) A model is presented which allows the determination of monthly river runoff values with the aid of satellite imagery. It transforms temperature weighted cloud cover index values into runoff. Application of RS to water management involves not only the development of new scientific techniques but also the economic aspects of such techniques. Various economic components influencing the prices of RS application to the solution of problems in practice are discussed. (See also W88-08470) (Author's abstract)

SNOW-MAPPING IN WESTERN GREEN-

Copenhagen Univ. (Denmark). Inst. of Geography. For primary bibliographic entry see Field 2C. W88-08478

PRESENT STATE, CHANGES AND QUALITY OF SOLOGNE AND BRENNE, TWO FRENCH LARGE WETLANDS, STUDIED WITH THE MSS AND TM LANDSAT DATA, Ministere de l'Environnement et du Cadre de Vie, Neuilly-sur-Seine (France). For primary bibliographic entry see Field 2H. W88-08480

STUDIES OF TIDAL FLAT ENVIRONMENTS WITH LANDSAT MSS DATA, Roskilde Universitetscenter (Denmark). For primary bibliographic entry see Field 2L. W38-08481

SAR APPLICATIONS WORKSHOP.

Wilson-Hill Associates, Inc., Washington, DC. Proceedings of an ESA Workshop held at Frascati, Italy, September 16-18, 1986. European Space Agency Report No. SP-264, December 1986. 123

Descriptors: *Workshops, *Remote sensing, *Synthetic aperture radar, *Data acquisition, Radar, Radargrammetry, Ice, Snow, Geohydrology, Agriculture, Sea ice.

Most of the papers presented at the workshop corresponded to current activities under ESA contract, so that the workshop offered an opportunity to assess the state of the art regarding key questions such as speckle filtering, application dependent segmentation, etc. Papers address the following topics: (1) Use of synthetic aperture radar (SAR) data for sea ice and polar ice, and snow and land ice; (2) Radargrammetry; (3) Geological feature extraction from SAR images; (4) Use of SAR data for agriculture and forestry; (5) SAR product simulations; (6) Ship and wake detection; (7) Line detection; and (8) Land use feature extraction. (See W88-08498 thru W88-08502) (Lantz-PTT) W88-08497

ACTIVE MICROWAVE OBSERVATIONS OF SEA ICE AND ICEBERG, Technical Univ. of Denmark, Lyngby.
H. Skriver, P. Gudmandsen, and L. Ulander.
IN: SAR Applications Workshop. Proceedings of an ESA Workshop held at Frascati, Italy, September 16-18, 1986. European Space Agency Report No. SP-264, December 1986. p 13-24, 14 fig. 6 tab, 29 ref.

Descriptors: *Data acquisition, *Microwaves, *Sea ice, *Icebergs, Synthetic aperture radar, Radar, Remote sensing, Backscattering, Satellite technolo-

Methods of automatic retrieval of sea ice parameters from synthetic aperture radar (SAR) and radar altimeter have been investigated. For classification of ice types and for reidentification of flocs in consecutive SAR images texture measures have been investigated. Statistical measures, measures of contrast and homogeneity, and co-occurence matrix measures have been studied. For the classification task the most simple measure, the ratio between the standard deviation and the mean appears to have the best performance. Furthermore, perween the standard deviation and the mean ap-pears to have the best performance. Furthermore, the texture measures were found to be correlated to some extent. For reidentification of floes the performance of the measures were modest, and more advanced methods must be developed. Pa-rameter retrieval from radar altimeter data based on a model of the backscattering mechanisms has on a model of the backscattering mechanisms has been investigated, and consistency was found from a comparison between a SEASAT SAR scene and overlapping altimeter data. Finally, the capability of a spaceborne SAR to detect icebergs has been investigated. (See also W88-08497) (Author's abstract) W88-08498

POTENTIAL OF SAR IN A SNOW AND GLACIER MONITORING SYSTEM, Innsbruck Univ. (Austria). Inst. fuer Meteorologie

Innsbruck Univ. (Austria). Inst. ruer Meteorologie und Geophysik.

H. Rott, C. Matzler, and D. Strobl.

IN: SAR Applications Workshop. Proceedings of an ESA Workshop held at Frascati, Italy, September 16-18, 1986. European Space Agency Report No. SP-264, December 1986. p 25-35, 8 fig. 3 tab,

Descriptors: *Remote sensing, *Data acquisition, *Synthetic aperture radar, *Snow, *Glaciers, Mon-itoring, Backscattering, Ice, Data interpretation, Landsat, Satellite technology.

The use of synthetic aperture radar (SAR) for snow and glacier applications as part of a multisensor land application system is investigated. New results on the physical properties and the signatures of backscattering of snow and ice are presental. The capabilities of sensors in the various spectral regions are compared. A synergistic data set has been analyzed using rectified airborne SAR and Landsat TM data. Investigations with additional data sets are soing on the come to find tional data sets are going on to come to final conclusions on the optimum use of SAR in an advanced earth observation system. (See also W88-08497) (Author's abstract)

SIMULATION OF SAR DATA PRODUCTS GEC-Marconi Electronics Ltd., Chelmsford (Eng-

Field 7—RESOURCES DATA

Group 7B-Data Acquisition

land). Marconi Research Centre.
S. Quegan, J. M. Lamont, R. J. Miller, P. J.
Meadows, and A. Wright.
IN: SAR Applications Workshop. Proceedings of
an ESA Workshop held at Frascati, Italy, September 16-18, 1986. European Space Agency Report
No. SP-264, December 1986. p 37-45, 4 fig, 21 ref.

Descriptors: *Simulation, *Synthetic aperture radar, *Data acquisition, *Remote sensing, Data bases, Clouds, Vegetation, Soils, Performance evaluation, Agriculture, Forestry, Radar, Model

The conditions a synthetic aperture radar (SAR) simulator must meet to be relevant to the needs of agriculture and forestry are presented. Several levels of simulation are identified, each requiring particular software tools; the feasibility of producing these tools is discussed. The major requirement is for a radar cross-section (RCS) database whose is for a radar cross-section (RCS) database whose input data is comprehensively described and of known accuracy; in addition, the experimental conditions must, in principle, he repeatable from the measurement description and the database must be linked to thoroughly understood theoretical models. The random medium, lossy scatterer and water cloud models are shown to have a similar through the random constitution. water cloud models are shown to have a similar structure, allowing comparability, but Peake's model for cereals and grasses has a different form. A prototype database has been constructed to clarify the issues. Also important is texture simulation; methods based on the autocorrelation function and the spatial grey-level dependency matrix (SGLDM) are described. More extensive comparison with data is required, and validation procedures must be developed. Examples of simulation textured regions and linear features are displayed. (See also W88-08497) (Author's abstract) W88-08500

STUDY ON THE USE OF SAR DATA FOR AGRICULTURE AND FORESTRY, DIGIM, Inc., Montreal (Quebec).
G. Rochon, C. Gosselin, M. Rheault, P. Vincent, and K. P. B. Thomson.
IN: SAR Applications Workshop. Proceedings of an ESA Workshop held at Frascati, Italy, September 16-18, 1986. European Space Agency Report No. SP-264, December 1986. p 81-93, 3 fig, 17 tab, 11 ref.

Descriptors: *Data processing, *Vegetation, *Data acquisition, *Remote sensing, *Synthetic aperture radar, *Agriculture, *Forestry, Model studies, Radar, Backscatter, Data interpretation, Wheat, Barley, Satellite technology.

The modeling of the radar backscatter from vegetation canopies using existing ground measure-ments; the processing techniques required to facilimeans; the processing techniques required to hachi-tate information extraction from noisy synthetic aperture radar (SAR) data; and the increase in information content brought about by the integra-tion of optical data with SAR data are considered with respect to the agriculture and the forestry applications. The merging of multi-temporal, multi-configuration SAR has been shown to allow reasonably high separability between canola, fallow and the two cereal crops, wheat and barley, combined. Discrimination between wheat and barley is low for most individual sensors examined but can be achieved with reasonable success when combining SAR and visible and near infrared image data. The limited amount of good quality data and the absence of C-band data within this data and the assence of C-band data within this study make any conclusion with respect to the potential of a satellite SAR such as ERS-1 in forestry applications premature. The results presented here suggest that the use of an X- or L-band SAR is very limited in this field of application. (See also W88-08497) (Lantz-PTT) W88-08501

LAND USE FEATURE DETECTION IN SAR

IAND USE FEATURE PROPERTY OF THE PROPERTY OF T

an ESA Workshop held at Frascati, Italy, September 16-18, 1986. European Space Agency Report No. SP-264, December 1986. p 95-102, 4 fig, 17 ref.

Descriptors: *Land use, *Data acquisition, *Remote sensing, *Image analysis, *Synthetic aperture radar, *Data interpretation, Radar, Automa-

Examined is the development of automatic methods for the interpretation of synthetic aperture radar (SAR) images. The study is based on two lines of argument: first, automatic methods must be closely related to specific application requirements and must satisfy those requirements if they are to be of use; and second, the performance of automatic operations must be quantitatively assessed. The objective of this paper is therfore to define applications and their requirements, and also to define precisely, manual interpretation routines so that they can be translated into machine operations. Also discussed are three techniques for automatic Also discussed are three techniques for automatic interpretation: segmentation, speckle reduction, and feature detection. A quantitative approach for assessing their performance is developed. (See also W88-08497) (Author's abstract) W88-08502

ION-CHROMATOGRAPHIC MEASURE-MENTS OF AMMONIUM, FLUORIDE, ACE-TATE, FORMATE AND METHANESULPHON-ATE IONS AT VERY LOW LEVELS IN ANT-ARCTIC ICE, Laboratoire de Glaciologie et Geophysique de l'Environnement, Saint-Martin d'Heres (France). For primary ibbliographic entry see Field 5A. W88-08546

FAULT-TOLERANT DESIGN FOR DATA AC-QUISITION AND FLOOD FORECAST SYS-TEMS, Sierra-Misco, Inc., Sacramento, CA. For primary bibliographic entry see Field 4A. W88-08548

MEASUREMENTS OF CHLOROPHYLL-A FROM PHYTOPLANKTON USING ETHANOL

FROM PHYTOPLANKTON USING ETHANOL AS EXTRACTION SOLVENT, Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab. For primary bibliographic entry see Field 2H. W88-08590

SPECTROFLUOROMETRIC DETERMINA-TION OF CHLOROPHYLLS AND PHEOPHY-

Laboratoire Arago, Banyuls-sur-Mer (France). For primary bibliographic entry see Field 2L. W88-08597

ROUTINE DETERMINATION OF PRINCIPAL GAMMA EMITTING RADIONUCLIDES IN MUDS AND SILTS FROM THE RIBBLE ESTU-

ARY, British Nuclear Fuels Ltd., Preston (England). Springfield Works. For primary bibliographic entry see Field 5A. W88-08606

NEUTRON ACTIVATION ANALYSIS OF NAT-URAL WATER SAMPLES USING CF-252 SOURCES, Chiang Mai Univ. (Thailand). Dept. of Chemistry. For primary bibliographic entry see Field 5A. W88-08611

IMPROVED EKMAN-BIRGE GRAB FOR SAM-PLING AN UNDISTURBED BOTTOM SEDI-MENT CORE SAMPLE, Nigata Univ. (Japan). Biological Lab. H. Fukuhara, and M. Sakamoto. Japanese Journal of Limnology RIZAA, Vol. 48, No. 2, p 127-132, April 1987. 2 fig, 1 tab, 19 ref.

Descriptors: *Bottom sampling, *Ekman-Birge grab, *Sediment sampler, *Lake sediments, In-situ

tests, Bacterial analysis, Chemical analysis, Sample preservation, Vertical distribution, Benthos, Sam-

An improved Ekman-Birge bottom mud sampler was devised for sampling undisturbed bottom sediment cores. The sediment and the overlying water were taken in a transparent plastic cylinder (diameter, 105 mm; height, 300 mm) house in the grab box. The grab was driven by an additional weight of 5 kg into the sediment. In situ tests for determining the vertical profiles of chemicals and bacterial populations in the overlying water and sediment proved successful for sampling undisturbed sediment for chemical and bacteriological studies was obtained in one trial. The grab was highly efficient for cobenthos collection, because it would sample sediment deeper than with the standard Ekmanigreg grab. It should thus be very useful for studies on the population dynamics of zoobenthos. (Author's abstract) W88-08638

IMPORTANCE OF KEEPING GOOD WELL PERFORMANCE RECORDS,

Water Well Journal WWJOA9, Vol. 42, No. 5, p 31-32, May 1988.

Descriptors: *Data collections, *Well data, *Pump wells, *Well logs, *Pump testing, *Water level, Documentation, Performance evaluation, Hydrostatic level, Pressure-measuring instrument

The importance of keeping accurate performance records has become more pronounced in recent years. Accurate records pertaining to the various components of a production well system can provide the data necessary for determining normal and abnormal operating conditions. A production well unit that exhibits a decline in productivity may be experiencing problems in one or more of its three component areas; the numning system, the may be experiencing problems in one or more of its three component areas: the pumping system, the well, or the aquifer. Performance parameters that should be monitored at least once a week on an active well unit include the static water level, the pumping water level, the electrical consumption, the pumping rate, and the back-pressure in the discharge line. A description of common pumping system, well and aquifer problems is also given. (VerNoav-PTD. system, well and (VerNooy-PTT) W88-08654

REVIEW OF SOIL SOLUTION SAMPLERS, Colorado Univ., Boulder. Inst. of Arctic and Alpine Research. M. I. Litaor.

Water Resources Research WRERAO, Vol. 24, No. 5, p 727-733, May 1988. 93 ref. National Science Foundation Grant BSR-8012095.

Descriptors: *Samplers, *Soil solution, *Soil analy-sis, *Interstitial water, *Lysimeters, *Water sam-pling, Soil properties, Soil tests, Technology, Lit-erature review, Optimization.

erature review, Optimization.

Soil interstitial waters are an extremely important facet of many environmental studies. The biogeochemical cycles of important nutrients, metal migration across the landscape, and pollutant movement to groundwater are highly affected by the water flow characteristics in soils and sediments. The purpose of this critical literature review is to evaluate the various soil solution sampling techniques. It has been recommended that the soil solution sampler system be installed a year before sampling begins. Some studies have indicated that the application of suction in a soil solution sampler gives results unlike freely percolating soil solution while other studies indicate that in practice the differences may be small. Physical considerations, e.g., macropores formed by decayed roots, and chemical considerations, e.g., volatile organics, soil solution pH, as well as the possibility of interference by animal or human activity must be included in the sampler design parameters. Types of samplers include ceramic, friited glass, hollow cellulose fibers and Teflon. Methods for sampling soil solutions other than tension lysimetry include the

Evaluation, Processing and Publication—Group 7C

use of an absorbent sponge material and an immis-cible displacement method. More research is needed in different soil environments for better evaluation of the number of samplers and repli-cates needed for a given research problem. (Ver-Noo.P.TT) Nooy-PTT) W88-08666

BIOMONITORING OF OIL SPILL IN A BOREAL ARCHIPELAGO BY XENOBIOTIC BIOTRANSFORMATION IN PERCH (PERCA FLUVIATILIS),

Kuopio Univ. (Finland). Dept. of Physiology. For primary bibliographic entry see Field 5C. W88-08672

VAJONT SLIDE: INSTRUMENTATION-PAST EXPERIENCE AND THE MODERN AP-

For primary bibliographic entry see Field 8E. W88-08704

SAMPLING AND GC-FID, GC/MS ANALYSIS OF PETROLEUM HYDROCARBONS IN THE OCEAN SURFACE MICROLAYER OF RICH-ARDS BAY, SOUTH AFRICA, National Inst. for Water Research, Pretoria (South

Africa)

For primary bibliographic entry see Field 5A. W88-08710

MEASUREMENT OF VOLATILE FATTY ACIDS IN PORE WATER FROM MARINE SEDIMENTS BY HPLC, Scottish Marine Biological Association, Oban. For primary biblic traphic entry see Field 5A. W88-08736

CIRCULATION AND MIXING IN LAKE RO-TONGAIO AND LAKE OKARO UNDER CON-DITIONS OF LIGHT TO MODERATE WINDS: PRELIMINARY RESULTS,

Western Australia Univ., Nedlands. Centre for Water Research.

For primary bibliographic entry see Field 2H. W88-08778

NEGATIVE STAINING OF FRESHWATER BACTERIONEUSTON SAMPLED DIRECTLY WITH ELECTRON MICROSCOPE SPECIMEN

WITH ELECTRUN MICROSCOPE STEEL SUPPORT GRIDS, Queensland Univ., Brisbane (Australia). Dept. of Microbiology. J. A. Fuerst, A. McGregor, and M. R. Dickson. Microbial Ecology MCBEBU, Vol. 13, No. 3, p 219-228, 1987. 7 fig, 33 ref.

Descriptors: *Sampling, *Bacteria, *Air-water interfaces, *Ponds, *Microbiological studies, *Electron microscopy, Australia, Bacterioneuston.

A technique for observation of surface microlayer bacteria (bacterioneuston) is described, using direct sampling of the air-water interface with carbon-stabilized electron microscope specimen support grids, followed by a negative staining and transmission electron microscopy. A eutrophic freshwater pond about 1-2 m deep, University Lake, located on the campus of the University of Queensland, St. Lucia, Brisbane, Australia, was used for all sampling. The method resulted in excellent preservation of forms of microcolonial association, regular surface arrays, surface appendages, and prosthecae surface arrays, surface appendages, and prosthecae in the bacterioneuston of a freshwater pond. (Au-thor's abstract) W88-08788

DETERMINATION OF POLYCYCLIC AROMATIC COMPOUNDS BY HIGH-PERFORM-ANCE LIQUID CHROMATOGRAPHY WITH SIMULTANEOUS MASS SPECTROPHOTOMETRY AND ULTRAVIOLET DIODE ARRAY DETECTION.

DETECTION, National Research Council of Canada, Halifax (Nova Scotia). Atlantic Research Lab. For primary bibliographic entry see Field 5A.

W88-08807

SEDIMENTATION RATES IN THE CENTRAL LAKE CONSTANCE DETERMINED WITH 210PB AND 137CS, Bern Univ. (Switzerland). Radiochemisches Lab. For primary bibliographic entry see Field 2H. W88-0882

TWO-DIMENSIONAL SHALLOW WATER FLOW IDENTIFICATION, Rijkswaterstaat, The Hague (Netherlands). Data Processing Div. For primary bibliographic entry see Field 2L. W88-08847

APPLICATION OF THE FINITE ELEMENT GROUNDWATER MODEL FEWA TO A RA-DIOACTIVE WASTE DISPOSAL SITE, Cale Bidge National I ab. TN Environmental Sci-Oak Ridge National Lab., TN. Environmences Div.

For primary bibliographic entry see Field 5B. W88-08848

POROUS CUP SAMPLERS: CLEANING PRO-CEDURES AND POTENTIAL SAMPLE BIAS FROM TRACE ELEMENT CONTAMINATION, California Univ., Santa Cruz. Dept. of Earth Sci-

For primary bibliographic entry see Field 5A. W88-08911

SAMPLING TECHNIQUES FOR GRAVEL SIZED SEDIMENTS.

SIZED SEDIMENTS, IOWA Univ., Jowa City. Dept. of Civil and Envi-ronmental Engineering. P. Diplas, and A. J. Sutherland. Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 5, p 484-501, May 1988. 7 fig. 3 tab, 17 ref.

Descriptors: *Sediment sampler, *Gravel, *Sampling, *Streams, Hydraulic engineering, Model studies, Hydraulic models, Gravel-bed streams, Cube models, Area-by-weight analyses, Bulk sieve analysis, Areal sampling.

The methods commonly used for sampling the coarser surface layers of gravel-bed streams are reviewed. It is found that while an areal sample is biased toward the coarser grains commond the coarser grains. reviewed. It is found that while an areal sample is biased toward the coarser grains compared with a volumetric sample of the same material, the conversion formula suggested by a voidless cube model overcompensates for this effect. A modified version of the cube model (based on the Kellerhals and Bray model) that accounts for its porosity is proposed. The modified cube model and tests conducted with a real sampling using wax indicate that area-by-weight analyses can be converted successfully to the equivalent bulk sieve analysis. The average depth of the wax samples ranged from D sub 63 to D sub 91, increasing with median grain size. The equivalence of the grid by number and bulk sieve analysis is reaffirmed. (Author's abstract) stract) W88-08914

TECHNIQUES OF COLLECTING DATA FOR A STUDY OF ERRORS IN MEASUREMENTS IN WATER METERS (LES TECHNIQUES D'A-QUISITION DE DONNEES POUR L'ETUDE
DES ERREURS DE COMPTAGE DANS LES
COMPTEURS À EAU,
For primary bibliographic entry see Field 5F.
W88-08921

STUDY OF THE INSTANTANEOUS EROSION OF CAVITATION, VERSUS FLOW, PRESSURE AND TEMPERATURE (ETUDE DE L'EROSION INSTANTEE DE CAVITATION EN FONCTION DE DEBIT, DE LA PRESSION ET DE LA TEMPERATURE), Ecole Superieure d'Electricite, Gif-sur-Yvette (France)

For primary bibliographic entry see Field 2J. W88-08957

7C. Evaluation, Processing and Publication

RAPID DETERMINATION OF MAGNESIUM AND CALCIUM HARDNESS IN WATER BY ION CHROMATOGRAPHY, Ames Lab., IA.

For primary bibliographic entry see Field 2K. W88-08021

WETLAND BOUNDARY DETERMINATION IN THE GREAT DISMAL SWAMP USING WEIGHTED AVERAGES, Geological Survey, Reston, VA. For primary bibliographic entry see Field 2H. W88-08036

APPLICATION OF KRIGING TO ESTIMATING MEAN ANNUAL PRECIPITATION IN A REGION OF OROGRAPHIC INFLUENCE, New Hampshire Univ., Durham. Dept. of Earth For primary bibliographic entry see Field 2B. W88-08040

GOES IR AND DUMMY VARIABLE TECHNIQUES FOR LOW TEMPERATURE ASSESS-MENT IN FLORIDA.

Florida Univ., Gainesville. Remote Sensing Applications Lab.

Cations Caso. S. F. Shih, and E. Y. Chen. Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 367-375, April 1988. 5 fig, 2 tab, 24 ref. NOAA Contract No. NA80AA-D-00129.

Descriptors: *GOES data, *Florida, *Remote sensing, *Satellite technology, *Temperature effects, *Air temperature, *Water table, *Infrared imagery, *Freezing, *Drainage, Soil types, Citrus fruits.

Geostationary Operational Environmental Satellite (GOES) thermal infrared (IR) data were used to study regional cold nocturnal temperature fluctuastudy régional cold nocturnal temperature fluctuations that are important in assessing citrus freeze
damage. Dummy variables techniques were used to
analyze the temperature difference between the
east and west sides of Central Florida, which was
obtained from both ground measurement minimum
temperature (T sub GOES) on low-temperature
nights. The low temperature pattern, which was
closely related to the citrus freeze damage pattern
in Central Florida, was identified by GOES thermal IR data but not by conventional ground meaurements. The low surface temperature in the west
ide and east side appears to be attributable to
differences in soil types, water tables, and drainage
classes in both regions. (Alexander-PTT)
W88-08044 W88-08044

MODELING THE PERFORMANCE OF DEEP WASTE STABILIZATION PONDS, Duke Univ. Durham, NC. Dept. of Civil and Environmental Engineering. For primary bibliographic entry see Field 5D. W88-80845

FRACTALS AND THE RIVER-LENGTH CATCHMENT-AREA RATIO, Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit. For primary bibliographic entry see Field 2E. W88-08053

PRECIPITATION CHARACTERISTICS FROM VARIABLE, HOURLY AND DAILY DATA BASES. Missouri Water Resources Research Center, Columbia.

For primary bibliographic entry see Field 2B. W88-08063

MODERN DIATOM ASSEMBLAGES IN CENTRAL MEXICO: THE ROLE OF WATER

Field 7—RESOURCES DATA

Group 7C-Evaluation, Processing and Publication

CHEMISTRY AND OTHER ENVIRONMENTAL FACTORS AS INDICATED BY TWINSPAN AND DECORANA, Stirling Univ. (Scotland). Dept. of Environmental

For primary bibliographic entry see Field 5C. W88-08082

PREDICTION OF THE 1979 SUMMER MON-SOON ONSET WITH MODIFIED PARAME-TERIZATION SCHEMES, European Centre for Medium Range Weather Forecasts, Reading (England). For primary bibliographic entry see Field 2B. W88-08117

GLOBAL ENERGY AND MOISTURE BUDG-ETS FROM RAWINSONDE DATA, Princeton Univ., NJ. Geophysical Fluid Dynamics Program.

For primary bibliographic entry see Field 2B. W88-08118

IMPROVING PRECIPITATION FORECASTS FROM THE METEOROLOGICAL OFFICE FINE-MESH MODEL BY USING A MODIFIED

EVAPORATION SCHEME, Meteorological Office, Bracknell (England). For primary bibliographic entry see Field 2B. W88-0819

APPLICATION OF SUPERCOMPUTERS TO WEATHER FORECASTING, Meteorological Office, Bracknell (England). For primary bibliographic entry see Field 2B.

PROGRESS IN THE DEVELOPMENT OF PAR-

AGON, Meteorological Office, Bracknell (England). For primary bibliographic entry see Field 2B. W88-08121

STRUCTURE OF A CONVERGENT CLOUD BAND OVER THE JAPAN SEA IN WINTER: A PREDICTION EXPERIMENT, Meteorological Research Inst., Yatabe (Japan). For primary bibliographic entry see Field 2B. W88-08122

ESTIMATION OF ATMOSPHERIC LIQUID-WATER AMOUNT BY NIMBUS SMMR DATA: A NEW METHOD AND ITS APPLICATION TO THE WESTERN NORTH-PACIFIC REGION, Nagoya Univ. (Japan). Water Research Inst. For primary bibliographic entry see Field 7B. W88-08123

NUMERICAL EXPERIMENTS OF THE CHARGING MECHANISM OF PRECIPITATION PARTICLES BY THE ION-CAPTURE PROCESS BELOW THE CLOUD BASE, Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics physics.
For primary bibliographic entry see Field 2B.
W88-08124

SPACE TRANSFORMATIONS IN THE STUDY OF MULTIDIMENSIONAL FUNCTIONS IN THE HYDROLOGICAL SCIENCES, Institute of Geology and Mineral Exploration, Athens (Greece).
For primary bibliographic entry see Field 2A.
W88-08178

DERIVATION OF SOME FREQUENCY DISTRIBUTIONS USING THE PRINCIPLE OF MAXIMUM ENTROPY (POME), iana State Univ., Baton Rouge. Dept. of Civil

Engineering. V.P. Singh, A.K. Rajagopal, and K. Singh. Advances in Water Resources AWREDI, Vol. 9, No. 2, p 91-106, June 1986. 2 fig, 8 tab, 45 ref.

Descriptors: *Statistics, *Mathematical models, *Hydrologic models, *Entropy, *Thermodynamics, Discharge, Frequency distributions, Principle

The principle of maximum entropy (POME) was employed to develop a procedure for derivation of a number of frequency distributions used in hydrology. The procedure required specification of constraints and maximization of entropy, and is thus a solution of the classical optimization problem. The POME led to a unique technique for parameter estimation. For 6 selected river gaging stations, parameters of the gamma distribution, the log-Pearson type III distribution and extreme value type I distribution fitted to annual maximum discharges, were evaluated by this technique and compared with those obtained by using the methods of moments and maximum likelihood estimation. The concept of entropy, used as a measure of uncertainty associated with a specified distribution, facilitated this comparison. (Author's abstract) W88-08183 W88-08183

DEVELOPMENT OF AN ENVIRONMENTAL DATA BASE FOR RIVERS, LAKES, AND RES-

Environmental Monitoring Systems Lab., Las

Environmental Municipal States NV.
K. F. Hedden, and R. L. Skaggs.
Journal of Environmental Science and Health (A)
JESEDU, Vol 23, No. 2, p 103-126, February
1988. 9 fig. 2 tab, 9 ref.

Descriptors: *Data collections, *Rivers, *Lakes, *Reservoirs, *Environmental data, *Data bases, *Path of Pollutants, *Model studies, Hydrology, Mathematical models, Exposure assessment, Toxins, Canonical Environments Data Base, Reach

One method for performing toxic substance exposure assessments is to use mathematical models that predict the transport and transformations of toxic substances in the environment. To run these models, a variety of input data on receiving waterbody properties and water-quality parameters that define a range of environments and influence the chemical-specific rate coefficients must be developed. This paper describes a data base developed by EPA for 15 major U.S. river basins that contains selected hydrologic and water-quality parameters. Called the Canonical Environments Data Base, the file brings together information developed by public and private organizations on each reach of the rivers as well as individual lakes and reservoirs in the basins. Coupling raw data with a data base management system in this environmenta file will facilitate entry into and deletions from the data base and development of data input to the Exposure Analysis Modeling System and other similar exposure assessment mathematical models. To assure compatibility with simplified process models, average monthly or seasonal values for each parameter are being stored in the data base. The structure of the data base is similar to that of the REACH file, and the EPA-developed data base that defines the hydrologic connections among rivers, their tributaries, and associated lakes and reservoirs. (Author's abstract) One method for performing toxic substance exposure assessments is to use mathematical models that

MISCIBLE FLOW THROUGH POROUS MEDIA WITH DISPERSION AND ADSORP-

Universidad Nacional de La Plata (Argentina). For primary bibliographic entry see Field 2F. W88-08348

ORTHOGONAL COLLOCATION AND ALTER-NATING-DIRECTION PROCEDURES FOR UN-SATURATED FLOW PROBLEMS.

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering. For primary bibliographic entry see Field 2G. W88-08351

ANALYSIS OF OBJECTIVE FUNCTIONS USED IN URBAN RUNOFF MODELS.

Purdue Univ., Lafayette, IN. School of Civil Engineering. For primary bibliographic entry see Field 4C. W88-08354

HYBRID RECEPTOR MODELS,

Environmental Protection Agency, Research Triangle Park, NC. Atmospheric Sciences Research Lab.

For primary bibliographic entry see Field 5B. W88-08447

TRACE ELEMENT CONCENTRATIONS ON FINE PARTICLES IN THE OHIO RIVER VALLEY, Maryland Univ., College Park. Dept. of Chemis-

For primary bibliographic entry see Field 5B. W88-08448

SIMULTANEOUS COLLECTION OF PARTI-CLES AND ACIDIC GASES FOR TRACING EMISSIONS FROM COAL-FIRED POWER PLANTS

Maryland Univ., College Park. Dept. of Chemis-

For primary bibliographic entry see Field 7B. W88-08449

RAINWATER CHEMISTRY NEAR AN ISO-LATED SO2 EMISSION SOURCE,

Washington Univ., Seattle. Dept. of Civil Engi-For primary bibliographic entry see Field 5B. W88-08459

DETECTION OF SOIL DRAINAGE IN 'PAYS DE HERVE' - BELGIUM - ON LANDSAT MSS IMAGERY, Ghent Rijksuniversiteit (Belgium). Lab. voor Re-gionale Geographie en Landschapskunde.

B. Otessens.

IN: Europe from Space. Proceedings of an ESA/ EARSeL Symposium held in Conjunction with EARSeL's General Assembly at the Technical University of Denmark, Lyngby, June 25-27, 1986. Report No. SP-258, December 1986. p 93-99, 6 fig, 7 tab, 18 ref.

Descriptors: *Soil water, *Data interpretation, *Drainage, *Remote sensing, *Pays de Hevre, *Belgium, Satellite technology, Landsat, Maps.

The detection of soil drainage conditions is studied, in the 'Pays de Herve' region which is mainly a grassland region, with different classes of soil drainage. Landsat MSS images are optically enhanced by using high gamma films. For the interpretation, the composite -4/-5 (enhanced) was used. Densitometric analysis shows a differentiation between well drained and poorly drained soils, and soils with perched water. Visual image analysis leads to PMU-maps. These maps are compared with the soil map and field data, making is possible to create a map of the soil drainage conditions in the 'Pays de Herve'. (See also W88-08470) (Lantz-PTT) The detection of soil drainage conditions is stud-W88-08474

USE OF AVHRR CHANNEL-3 DATA FOR EN-VIRONMENTAL STUDIES, Dundee Univ. (Scotland). Physics Lab. For primary bibliographic entry see Field 7B. W88-08476

SNOW-MAPPING IN WESTERN GREEN-LAND,

Copenhagen Univ. (Denmark). Inst. of Geography. For primary bibliographic entry see Field 2C. W88-08478

MODEL OF THERMAL INERTIA FOR FROST FORECASTING IN AGRICULTURAL AREAS, Valencia Univ. (Spain). Faculty of Physics.

ENGINEERING WORKS—Field 8

Structures—Group 8A

V. Caselles, M. J. Salom, J. Delegido, and S.

Gandia.

IN: Europe from Space. Proceedings of an ESA/
EARSeL Symposium held in Conjunction with
EARSeL's General Assembly at the Technical
University of Denmark, Lyngby, June 25-27, 1986.
Report No. SP-258, December 1986. p 253-257, 2
fig. 2 tab, 17 ref.

Descriptors: *Thermal inertia, *Frost, *Data interpretation, *Agriculture, Forecasting, Model studies, Irrigation, Vegetation, Spain, Remote sensing, Temperature, Evapotranspiration.

The Valentian region (Spain) is classified in different thermally homogeneous zones, to carry out frost forecasting for these small zones. The classifying parameter used has been thermal inertia because is considered to be a good index of the system ground-vegetation when its temperature changes. For managing frost forecasting, Price's model for thermal inertia estimation has been modified by adding the evapotranspiration term. Since evapotranspiration in irrigated lands mainly depends on crops, this forecasting is made from the maximum temperature made from the maximum temperature made from the maximum temperature image obtained by remote sensing, and the crop image. (See also W88-08470) (Author's abstract)

PRESENT STATE, CHANGES AND QUALITY OF SOLOGNE AND BRENNE, TWO FRENCH LARGE WETLANDS, STUDIED WITH THE MSS AND TM LANDSAT DATA, Ministere de l'Environnement et du Cadre de Vie, Neuilly-sur-Seine (France). For primary bibliographic entry see Field 2H. W88-08480

STUDIES OF TIDAL FLAT ENVIRONMENTS WITH LANDSAT MSS DATA, Roskilde Universitetscenter (Denmark). For primary bibliographic entry see Field 2L. W88-08481

STUDY ON THE USE OF SAR DATA FOR AGRICULTURE AND FORESTRY, DIGIM, Inc., Montreal (Quebec). For primary bibliographic entry see Field 7B.

LAND USE FEATURE DETECTION IN SAR Hunting Technical Services Ltd., Borehamwood (England). For primary bibliographic entry see Field 7B. W88-08502

REGIONAL GROUND-WATER FLOW NEAR REGIONAL GROUND-WATER FLOW NEAR RICHTON AND CYPRESS CREEK DOMES, MISSISSIPPI: ANNUAL STATUS REPORT FOR FISCAL YEAR 1984. Earth Technology Corp., Long Beach, CA. For primary bibliographic entry see Field 2F. W88-08511

PHOTOCHEMICAL MODELING APPLIED TO NATURAL WATERS, Rosenstiel School of Marine and Atmospheric Sci-ence, Miami, FL. Div. of Marine and Atmospheric

For primary bibliographic entry see Field 2K. W88-08539

MEASUREMENT OF QUANTUM YIELDS IN POLYCHROMATIC LIGHT: DINITROANI-

LINE HERBICIDES, Minnesota Univ., Minneapolis. School of Public For primary bibliographic entry see Field 5B. W88-08540

FIELD VERIFICATION OF HELP MODEL FOR LANDFILLS,

Missouri Univ.-Columbia. Dept. of Civil Engineer-For primary bibliographic entry see Field 5E. W88-08568

EFFECTS OF STORM AND GAGE LOCATION ON TRIBUTARY LOAD ESTIMATE, Ohio State Univ., Columbus. Dept. of Civil Engineering. For primary bibliographic entry see Field 7A. W88-08574

GAS TRANSFER KINETICS IN OXYGEN ACTI-Arkansas State Univ., State University. Dept. of Civil Engineering. For primary bibliographic entry see Field 5D. W88-08577

STUDIES ON THE MOTION OF GROUND WATER WITH DISPERSION IN COASTAL AQUIFERS: IV. NUMERICAL ANALYSIS BASED ON TWO-DIMENSIONAL UNSTEADY STATE MODEL, (IN JAPANESE), Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.

For primary bibliographic entry see Field 2F. W88-08637

MUDEL ANALYSIS OF THE TRANSPORT OF SOLUTES IN SATURATED AND UNSATURATED DOMAINS, (IN JAPANESE), Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering. For primary bibliographic entry see Field 5B. W88-08651 MODEL ANALYSIS OF THE TRANSPORT OF

SEQUENTIAL ESTIMATION OF AQUIFER PARAMETERS, Westinghouse Hanford Co., Richland, WA. For primary bibliographic entry see Field 2F. W88-08660

NEW ANALYTIC FUNCTION FOR MODEL-ING PARTIALLY PENETRATING WELLS, Indiana Univ., Bloomington. School of Public and Environmental Affairs. For primary bibliographic entry see Field 2F. W88-08661

COMPARISON OF NEWTON-TYPE AND DIRECT SEARCH ALGORITHMS FOR CALIBRATION OF CONCEPTUAL RAINFALL-RUNOFF MODELS, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. For primary bibliographic entry see Field 2A. W88-08662

DIFFUSION WAVE MODEL FOR OVERLAND FLOW: I. SOLUTION FOR STEEP SLOPES, California Univ., Davis. Dept. of Civil Engineer-For primary bibliographic entry see Field 2E. W88-08667

DIFFUSION WAVE MODEL FOR OVERLAND FLOW: II, STEADY STATE ANALYSIS, California Univ., Davis. Dept. of Civil Engineer-For primary bibliographic entry see Field 2E. W88-08668

DEVELOPING JOINT PROBABILITY DISTRIBUTIONS OF SOIL WATER RETENTION CHARACTERISTICS, Environmental Research Lab., Athens, GA. For primary bibliographic entry see Field 2G. W88-08669

SAMPLING AND GC-FID, GC/MS ANALYSIS OF PETROLEUM HYDROCARBONS IN THE

OCEAN SURFACE MICROLAYER OF RICHARDS BAY, SOUTH AFRICA, National Inst. for Water Research, Pretoria (South Africa).

For primary W88-08710 nary bibliographic entry see Field 5A.

DAILY STUDY OF THE DIATOM SPRING BLOOM AT ROSCOFF (FRANCE) IN 1985: I. THE SPRING BLOOM WITHIN THE ANNUAL CYCLE.

CYCLE, Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France). For primary bibliographic entry see Field 21. W88-08725

TEMPORAL VARIATIONS OF SECONDARY PRODUCTION IN THE MARINE BIVALVE SPISULA SUBTRUNCATA OFF THE PORIVER DELTA (ITALY), Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. For primary bibliographic entry see Field 2H. W88-08726

DEVELOPMENT OF A WATER QUALITY PLANNING MODEL USING UTM SOUARE-GRID SYSTEM, Institut National de la Recherche Scientifique, Scinte-Foy (Quebec).
For primary bibliographic entry see Field 5G.
W88-08853

IMPROVED FITTING FOR THREE-PARAME-TER MUSKINGUM PROCEDURE, Lancaster Univ. (England). Dept. of Environmental Science nary bibliographic entry see Field 2E. For primar W88-08916

8. ENGINEERING WORKS

8A. Structures

RELIABILITY-BASED DESIGN CONCEPTS IN HYDRAULIC ENGINEERING, Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft. E. J. Plate, and L. Duckstein. ources Bulletin WARBAQ, Vol. 24, No. 2, p 235-245, April 1988. 8 fig, 19 ref.

Descriptors: *Hydraulic engineering, *Safety, *Levees, *Hydrology, *Reliability, *Stochastic process, *Design standards, *Design criteria, Mathematical studies, Load, Probability distribution, Stochastic process.

Different probability-based concepts for design of hydraulic structures are presented that could replace or complement traditional designs based on the concept of design load plus a safety margin. The traditional concept (here called Level I design) does not permit the assignment of the correct probability to the failure event. Concepts which are based on the correct probability of failure are based on descriptions of resistance and load as random variables. Level II design assumes random variables to be Gaussian distributed. Level III is based on arbitrary distributions of load and resistance. Level II and III concepts are appropriate for evaluation of a design's reliability. Design Level IV is also based on the joint probability density function for loads and resistances, in addition, it requires the assignment of a consequence tion, it requires the assignment of a consequence function to each combination of resistance and loads. The design concepts are illustrated with the design of a flood levee on a river. (Author's ab-V88-08028

INJECTING AN OXYGEN FIX. Corps of Engineers, Savannah, GA. Savannah Dis-For primary bibliographic entry see Field 5G.

Field 8—ENGINEERING WORKS

Group 8A—Structures

W88-08142

DAMS AND EARTHQUAKES: A SHAKY RELA-TIONSHIP,

For primary bibliographic entry see Field 8E. W88-08143

FIELD PERFORMANCE OF CORRUGATED POLYETHYLENE PIPE CULVERTS IN OHIO, Ohio Dept. of Transportation, Columbus. For primary bibliographic entry see Field 8G. W88-08192

EVALUATION OF METAL DRAINAGE PIPE DURABILITY AFTER TEN YEARS,

Louisiana Dept. of Transportation and Develop-ment, Baton Rouge. Research and Development

W. H. Temple, and S. L. Cumbaa. Transportation Research Record TRREDM, No. 1087, p 7-14, October, 1987. 7 fig, 6 tab, 2 ref.

Descriptors: *Durability, *Drainage, *Pipes, *Pipelines, *Corrosion control, Inspection, Per-formance evaluation, Hydrogen ion concentration, Louisiana, Resistivity, Soil properties, Culverts, Engineering, Structural engineering, Field tests, Mechanical failure, Hydraulic structures.

The comparative performance of coated and un-coated, corrugated, galvanized steel, and aluminum drainage pipe was investigated in Louisiana. The highly corrosive environments in some areas of the state make durability requirements critical. Ten types of metal drainage pipes were installed in pairs at each of 10 locations in 1973. Every 2 years, pairs at each of 10 locations in 1973. Every 2 years, one designated culvert of each of the pairs was removed and subjectively rated by a panel. The final (10-year) panel ratings reflect the condition of the undisturbed culverts in each pair. It was found that, in general, the 16-gauge asphalt-coated aluminum; the 14-gauge asbestos-bonded, asphalt-coated galvanized steel; and the 16-gauge galvanized steel with a 12-mil interior and a 5-mil exterior polyethylene coating were the test pipes with the most resistance to corrosion at the majority of the test sites. It was also found that, although all of the coatings provided added resistance to corrosion to some degree, the thicker coatings tested provided increased protection to the base metal. Comparisons of actual versus predicted years to perforation sons of actual versus predicted years to perforation are made for galvanzed steel in the harsher environments where test culverts actually experienced perforation. (Author's abstract) W88-08193

ABRASION RESISTANCE OF ALUMINUM CULVERT BASED ON LONG-TERM FIELD PERFORMANCE, Koepf and Lange, Inc., Lafayette, CA. For primary bibliographic entry see Field 8G. W88-08194

LOCK REHABILITATION, A PUBLIC INFRA-STRUCTURE PROBLEM: THE VALUE OF IN-CREASED PRODUCTIVITY IN MEAN LOCK-

AGE PERFORMANCE, Army Engineer Inst. for Water Resources, Fort Belvoir, VA.

C. E. Yoe.

Available from the National Technical Information
Service, Springfield, VA 22161, as AD-A184 386.
Price codes: A06 in paper copy, A01 in microfiche.
Corps of Engineers Institute for Water Resources
Report No. IWR Report 87-R-1, January 1987. 181
p, 13 fig, 15 tab, 157 ref, 5 append.

Descriptors: *Locks, *Maintenance, *Performance evaluation, *Navigation, *Cost analysis, *Infrastructure, Mississippi River, Productivity, Economic aspects, Hydraulic models, Model studies, Costs, Hydraulic structures.

The nation's inland waterways infrastructure is aging and in need of rehabilitation and replacement. Economic analyses to date have overlooked the value of increased mean productivity which result from lock rehabilitation. Productivity in-

creases are measured in terms of decreases in the mean time it takes a tow to transit a lock. The analysis develops a dynamic model for estimating these values. The quantity of public infrastructure capital, i.e., lock capital, cannot be estimated by any of the commonly accepted price or quantity methods due to lack of data. Lock capital is estimated with price data and estimates of asset functions. A recursive system of equations with exogenous demand for lockages at the lock to be rehabilitated is estimated to show the effect of lock capital on transit time. An increase in lock capital is shown to decrease mean values of: (1) the time it takes to service a tow; (2) queue length; and (3) the total transit time required to pass through a lock. The model is solved for Lock and Dam 13 on the Mississippi River. The value of the improved productivity is minimal and relatively insensitive to variations in model assumptions or the estimation of the quantity of capital. Results indicate a need for data on the physical characteristics of public infrastructure capital so its quantity can be estimated. The value of improvements in infrastructure's mean productivity appear to be insignificant when compared to the value of preventing economic losses which could result from failure or loss of the infrastructure. The importance of an empirical basis for estimating the probability of infrastructure failure is pointed out as is the current lack of data to do this. (Author's abstract) creases are measured in terms of decreases in the failure is pointed out as is the current lack of data to do this. (Author's abstract) W88-08408

SWEETWATER RIVER CHANNEL IMPROVE-MENT PROJECT, SAN DIEGO COUNTY, CALIFORNIA. HYDRAULIC MODEL INVES-TIGATION.

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. For primary bibliographic entry see Field 8B. W88-08419

REPAIR OF DAM INTAKE STRUCTURES AND CONDUITS: CASE HISTORIES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab. R. L. Campbell, and D. L. Bean.

R. L. Campoeti, and D. L. Bean. Available from the National Technical Information Service, Springfield, VA. 22161. Technical Report. No. REMR-CS-16, January 1988. Final Report. 100 p, 52 fig. 2 tab, 14 ref.

Descriptors: *Dams, *Intakes, *Case studies, *Hydraulic structures, *Conduits, *Maintenance, Intake gates, Concrete, Erosion, Urethane, Grout-

Based on a survey of inspection reports, 29% of the maintenance and repair problems at Corps of Engineers dams were in intake structures and conduits. Repairs to these structures did not perform as desired in > 40% of the reported efforts, with > 21% reported as failed. A number of products whose manufacturer's literature indicated that they were suited for application in a wet environment, such as that found in intake structures and conduits failed. In some instances, the repair technique was at fault. In others, the product failed to perform as indicated. Selected repair efforts to intake structures and conduits are presented in a case history turners and conduits are presented in a case history. indicated. Selected repair efforts to intake structures and conduits are presented in a case history format that includes a project description and a history of the repair efforts. The project description identifies principal project features and gives a detailed description of the deficiency being repaired to include its history and cause (if known). The descriptions of repair efforts are presented chronologically for each project. The two most common types of concrete deficiencies were leakage from cracks and joints and cavitation erosion damage to conduit passageways immediately damage to conduit passageways immediately downstream of gates. The most successful method documented for reducing leakage through both cracks and joints was chemical (urethane) grout-ing. The most successful method documented for ing. The most successful memora documented for withstanding cavitation damage was resurfacing of damaged area using a product called Belzona Magma Quartz. However, before a recommendation can be made, laboratory testing is needed to further substantiate the quartz product's potential for cavitation repair. (Lantz-PTT) W88-08426

EMBANKMENT DAMS ON PERMAFROST: DESIGN AND PERFORMANCE SUMMARY, BIBLIOGRAPHY, AND AN ANNOTATED BIB-LIOGRAPHY

Cold Regions Research and Engineering Lab., Hanover, NH.

F. H. Sayles.

Available from the National Technical Information
Service, Springfield, VA. 22161, as AD-A184 163.

Price codes: A06 in paper copy, A01 in microfiche.
Special Report No. 87-11, July 1987. 109 p, 7 fig, 1

Descriptors: *Embankment dams, *Cold regions, *Permafrost, *Dams, Hydraulic structures, Literature review, Frozen ground, Construction methods, Dam foundation.

ods, Dam foundation.

The designs of embankment dams on permafrost can be divided into two general types, frozen and thawed. The frozen type of embankments and their foundations are maintained frozen during the life of the structure. The thawed type of embankments usually are designed assuming that the embankment will remain unfrozen and its permafrost foundation will thaw during construction or during the operation of the structure. In some locations where water is to be retained intermittently for short periods of time, thawed embankments have been designed assuming the permafrost will remain frozen throughout the life of the embankment. In selecting this type of design for a particular site, many factors that are peculiar to cold regions must be considered. A summary of methods of design, construction and operation of embankment dams in permafrost areas records the successes and some railures that have occurred. Embankment dams have been built and successfully operated in Canada, Greenland, the USSR and Alaska. As number of failures have been reported in the USSR and one in Alaska. Most of the difficulties arose because insufficient attention was given to establishing and maintaining a reliable frozen condition and to controlling seepage. Often the thawing and seepage unto force memankment or foundation are imitiated adjacent to the spillway or outlet works indicating that inadequate cooling or impervious seepage cutoffs were established at these points. (Author's abstract) W88-08429

IMPACT OF HYDROELECTRIC DEVELOP-MENT ON THE AMAZONIAN ENVIRON-MENT: WITH PARTICULAR REFERENCE TO THE TUCURUI PROJECT,

University Coll. of Swansea (Wales). Centre for Development Studies. For primary bibliographic entry see Field 6G.

WRR DRAM

DEVELOPMENT OF LABYRINTH SPILLWAY

Mahab Ghods Consulting Engineers, Tehran For primary bibliographic entry see Field 8B. W88-08615

SLUICE DIMENSIONING FOR DESILTING RESERVOIRS,

Irrigation and Power Research Inst., Amritsar (India). For primary bibliographic entry see Field 8B. W88-08616

PLANNING THE USEFUL LIFE OF A RESER-VOIR, Detroit Water and Sewerage Dept., MI.

M. A. Gill.

International Water Power and Dam Construction IWPCDM, Vol. 40, No. 5, p 46-47, May 1988. 4

Descriptors: *Useful life, *Reservoirs, *Reservoir capacity, *Sedimentation, *Design standards, *Design criteria, Dam construction, Mathematical studies, Statistical methods, Civil engineering, Performance evaluation, Model studies, Sediments.

ENGINEERING WORKS—Field 8

Hydraulics-Group 8B

A simplified method for the calculation of reservoir sedimentation rates is proposed; this can be used to reveal the loss of a reservoir's capacity in a given time period or its total useful life. The author has refined the equations incorporated in his original article on the subject. The proposed method of computing loss of reservoir capacity because of sedimentation in a given period of time, or computing the useful life of the reservoir, is simpler than the previously used method. At the same time, the method proposed here is believed to be more accurate, since the time variation of the specific weight of sediments is explicitly treated in the analysis. In the previous method, the specific weight was treated as a constant and taken as the average value. (Author's abstract)

REVIEW OF THE BALDWIN HILLS RESER-VOIR FAILURE, For primary bibliographic entry see Field 8D. W88-08690

FAILURE OF BALDWIN HILLS RESERVOIR, 1963-INTERPRETATION OF STEP-BY-STEP FAILURE SEQUENCE, For primary bibliographic entry see Field 8D. 1982-1963

GROUND SUBSIDENCE ANALYSIS PRIOR TO THE BALDWIN HILLS RESERVOIR FAIL-URE, For primary bibliographic entry see Field 8D. W88-08692

FAILURE OF TETON DAM, California Univ., Berkeley. Dept. of Civil Engineering. For primary bibliographic entry see Field 8E.

TETON DAM FAILURE-A DISCUSSION, For primary bibliographic entry see Field 8E. W88-08694

TETON INVESTIGATION-A REVIEW OF EX-ISTING FINDINGS, For primary bibliographic entry see Field 8E. W88-08695

LESSONS FROM THE TETON DAM FAILURE, J. L. Sherard. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p. 239-256, December 1987. 2 fig. 13 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Teton Dam, Idaho, Earth dams, Dam foundations, Foundations, Design criteria, Erosion, Leakage, Seepage, Embankments, Grouting, Hydraulic fractures.

Several lessons were learned from the failure of the Teton Dam. (1) No fundamental changes in current practice for dam design are required. (2) The design for Teton was unacceptable because it did not provide for the needed conservative rock surface crack sealing and filters. (3) Bureaucratic restrictions limited the design and construction control staffs. (4) Failure resulted from an initial erosive concentrated leak which developed in the erodible fine silt zone. (5) The initial leak could have developed directly in the zone by hydraulic fracturing or along the embankment rock interface at the bottom of the trench. (6) If a leak had not developed during the first filling, the dam would have failed eventually by the same mechanism. (7) Independent review of design is essential. (8) Wet seams formed near horizontal water-filled cracks which were opened by hydraulic fracturing during filling. (9) The concentrated leak occurred in an impervious section of the dam on the right abutment in spite of good construction practices. (Cassar-PTT)

MALPASSET DAM FAILURE,

For primary bibliographic entry see Field 8E. W88-08697

MALPASSET DAM FAILURE, Laboratoire de Mecanique des Solides, Palaiseau (France). P. Habib.

Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 331-338, December 1987. 3 fig, 2 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs,

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, Malpasset Dam, France, Arch dams, Concrete, Dam foundations, Foundations, Hydrostatic pressure, Geologic fissures, Permeability, Pore pressure, Stress.

sty, Pore pressure, Stress.

Studies of the rocks at the foundation of the failed Malpasset Dam showed correlation between the degree of fissuration and (1) scale effect in uniaxial compression tests, (2) scatter of results, and (3) the significant effect of effective stress on permeability. The problem of extrapolating information obtained from a rock sample to a rock mass was emphasized. The rock mass involves fissures, joints, diaclases, and fault systems which cannot be duplicated in a small sample. Stress applied by a dam closes the fissures running roughly normal to the direction of stress, reducing the permeability of the rock. If water flows in the fissures according to Darcy's law, widespread pressure losses occur, further modifying the stress distribution. In the least permeable areas, the pressure losses will be highest, often behaving as a cutoff. If the rock is only slightly fissured relative to porosity, the stress pattern under an abutment may not be modified significantly. In the Malpasset situation the stress pattern was fundamentally disturbed. (Cassar-PTT)

LATEST THINKING ON THE MALPASSET ACCIDENT, For primary bibliographic entry see Field 8E. W88-08699

MALPASSET DAM DISCUSSION-REMEM-BRANCES OF FAILURES OF DAMS, Coimbra Univ. (Portugal). Seccao Autonoma de Engenharia Civil. For primary bibliographic entry see Field 8E. W88-08700

MODIFIED HYPOTHESIS FOR FAILURE OF MALPASSET DAM, Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. füer Grundbau, Bodenmechanik, Felsmechanik und Verkehrswasserbau. For primary bibliographic entry see Field 8E. W88-08701

MALPASSET DAM, Coyne et Bellier, Paris (France). For primary bibliographic entry see Field 8E. W88-08702

VAJONT CATASTROPHE-A PERSONAL REVIEW, For primary bibliographic entry see Field 8E. W88-08703

VAJONT SLIDE: INSTRUMENTATION--PAST EXPERIENCE AND THE MODERN AP-PROACH, For primary bibliographic entry see Field 8E. W88-08704

VAJONT SLIDE--A GEOTECHNICAL ANALY-SIS BASED ON NEW GEOLOGIC OBSERVA-TIONS OF THE FAILURE SURFACE, Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering. For primary bibliographic entry see Field 8E. W88-08705

VAJONT RESERVOIR SLOPE FAILURE,

For primary bibliographic entry see Field 8E. W88-08706

VAJONT SLIDE, For primary bibliographic entry see Field 8E. W88-08707

ASPECTS OF THE VAJONT SLIDE, Wollongong Univ. (Australia). Dept. of Civil and Mining Engineering. For primary bibliographic entry see Field 8E. W88-08708

PREVENTION OF CONTAMINATION (PRE-VENTION DE LA CONTAMINATION), Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands). For primary bibliographic entry see Field 5F. W88-08922

8B. Hydraulics

RELIABILITY-BASED DESIGN CONCEPTS IN HYDRAULIC ENGINEERING, Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft. For primary bibliographic entry see Field 8A. W88-08028

PRACTICAL PREDICTION OF SECOND-ORDER WAVE DIFFRACTION CAUSED BY LARGE OFFSHORE STRUCTURES, Technical Univ. of Nova Scotis, Halifax. Dept. of Applied Mathematics.

Advances in Water Resources AWREDI, Vol. 9, No. 2, p 58-69, June 1988. 7 fig, 8 ref, append.

Descriptors: *Mathematical models, *Hydrologic models, *Offshore platforms, *Waves, *Ocean waves, *Design standards, Second-water wave diffraction.

An ad-hoc method of estimating second-order wave loads on square caissons has been formulated for design purposes. Following Lighthill's second-order theory, theoretical expressions for wave loads on offshore structures were obtained. Comparison between the predicted and available measured values was extremely good. A computer program was written in Fortran for use on a CDC Cyber 185 digital computer. A Simpson's integration scheme was formulated and used to integrate with very fine grid size. (Brock-PTT) W88-08179

EVALUATING FLOOD RETARDING STRUC-TURES, Hydrosystems Engineers, Colorado Springs, CO. W.F. Rogers, and V.P. Singh. Advances in Water Resources AWREDI, Vol. 9, No. 4, p 236-244, December 1986. 6 fig, 3 tab, 6 ref.

Descriptors: *Flood control, *Runoff, *Dams, *Mathematical studies, *Flood peak, Channel flow.

An empirical relation between volume and peak of runoff (VPR) was utilized to determine peak discharge reduction effectiveness of flood retarding structures. The effectiveness was evaluated by comparing the predam VPR relation with a preand post-dam channel length frequency distribution (CLFD) for the point of interest. The procedure involved well-related hydrologic and geomorphic variables and thus could be a practical prediction tool. The proper location of a dam to intercept concentrated channel frequencies was most important for effectiveness of flood reduction. (Brock-PTT)
W88-08191

MECHANICS OF INCOMPRESSIBLE MULTI-PHASE SUSPENSIONS, Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Industrial Engineering.

Field 8—ENGINEERING WORKS

Group 8B—Hydraulics

G. Ahmadi. Advances in Water Resources AWREDI, Vol. 10, No. 1, p 32-43, March 1987. 40 ref, append.

Descriptors: *Fluid mechanics, *Multiphase flow, *Particulate matter, *Hydrodynamics, *Suspensions, *Suspended models, Theoretical analysis, Thermodynamics, Settling velocity.

The mechanics of incompressible multiphase particulate suspensions in a liquid are considered. The basic conservation laws are derived via a spatial averaging method. The thermodynamics of the multiphase system is studied and the appropriate constitutive equations are developed. The basic equations of motion of various constituents are derived and discussed. The model includes the effects of pressure differences in various phases, diffusion forces, equilibrated forces and virtual mass forces. A simplified version of the model is used and the problem of gravity sedimentation is treated. The model leads to a stable uniform settling rate. (Author's abstract)

PRIMITIVE PSEUDO WAVE EQUATION FOR-MULATION FOR SOLVING THE HARMONIC SHALLOW WATER EQUATIONS, Texas A and M Univ., College Station. Ocean

Engineering Program.
J. J. Westerink, J. J. Connor, and K. D.

Stoltenbach.

Advances in Water Resources AWREDI, Vol. 10, No. 4, p 188-199, December 1987. 8 fig. 11 ref.

Descriptors: *Hydraulics, *Shallow water, *Wave equation, *Finite element method, Mathematical analysis, Fourier analysis, Mathematical equations.

analysis, Fourier analysis, Mathematical equations. A finite element method formulation for solving the harmonic shallow water equations in their primitive or unmodified form is developed and analyzed. The Primitive Pseudo Wave Equation Formulation (PPWE) involves developing a weak weighted residual form of the continuity equation and forming a pseudo wave equation by substituting the discretized form of the momentum equation into the discretized form of the continuity equation. The final set of equations to be solved, the pseudo wave equation and the primitive momentum equations, deceptively resemble the discretized equations of the wave equation formulation of Lynch and Gray. Despite this resemblance, Fourier analysis indicates that the PPWE scheme is still fundamentally primitive. However, application of the PPWE scheme to a set of stringent test problems results in very good solutions with well controlled nodal oscillations. This low degree of spurious oscillations is due to the treatment of the boundary conditions such that elevation is taken as an essential condition and normal flux is taken as an assential condition and normal flux is taken as an assural condition. This particular boundary condition treatment is suggested by the formation of the pseudo wave equation. Even though the equation rearrangement does not in itself effect the solutions, it does make the scheme much more efficient. (Author's abstract) cient. (Author's abstract) W88-08352

SOLUTION OF THE TIME-DEPENDENT CON-VECTION-DIFFUSION EQUATION BY THE FINITE ELEMENT METHOD,

FINITE ELEMENT METHOD, Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering. J. C. Heinrich, and C.-C. Yu. Advances in Water Resources AWREDI, Vol. 10, No. 4, p 220-224, December 1987. 1 fig, 4 tab, 7 ref. American Chemical Society, Petroleum Research Fund Grant PRF 15533-AC5.

Descriptors: *Hydraulics, *Routing, *Flow equations, *Convection-diffusion equation, Finite element method, Petrov-Galerkin method, Algons, Mathem atical equations.

A Petrov-Galerkin finite element method is pre-sented for the time-dependent convection-diffusion equation. The scheme is based on bilinear time-space trial and quadratic in time-linear in space test functions, the latter being nonconforming. Second

order in time and third order in space accuracy is obtained, and the schemes are free of numerical diffusion and dispersion effects. Numerical results are presented which show excellent approximation properties. (Author's abstract) W88-08356

HYDRAULIC DESIGN OF CULVERTS ON FOREST ROADS, British Columbia Univ., Vancouver. Faculty of

Forestry.

J. P. Donahue, and A. F. Howard.

Canadian Journal of Forest Research CJFRAR,
Vol. 17, No. 12, p. 1545-1551, December 1987. 5
fig, 3 tab, 21 ref.

Descriptors: *Culverts, *Drainage ditches, *Pipes, *Inlets, *Hydraulic design, *Road construction, Computer models, Forests, Algorithms.

Design of drainage structures is an important part of planning forest roads, which usually includes culverts. Determining the appropriate pipe size for a given site involves estimation of expected flows and evaluation of the hydraulic performance of pipes of different sizes. A review of the hydraulic relationships applicable to the evaluation of pipe hydraulics is presented. A computer model is introduced that incorporates these relationships. The model is used to compare two algorithms for computing headwater depths, given inlet control (supercritical flow). The relative efficiency of four inlet types was also investigated. Results indicate that potential cost savings exist by altering inlet geometry and that computer-assisted design can facilitate accommodation of conflicting design goals. (Author's abstract)

SWEETWATER RIVER CHANNEL IMPROVE-MENT PROJECT, SAN DIEGO COUNTY, CALIFORNIA. HYDRAULIC MODEL INVES-

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab. H. O. Turner

H. O. Turner.

Available from the National Technical Information
Service, Springfield, VA. 22161, as AD-A161 050.
Price codes: A05 in paper copy, A01 in microfiche.
Technical Report No. HL-88-3, February 1988.
Final Report. 64 p, 4 fig. 17 photos, 29 plates.

Descriptors: *Sweetwater River, *Maintenance, *San Diego, *California, *Channel improvement, Channels, Hydraulic models, Hydraulic structures, Flow patterns, Model studies, Levees, Spillways.

The Sweetwater River is located in San Diego County, California. In the area of proposed improvement, the Sweetwater River is a poorly defined channel varying from 1,200 to 2,000 ft wide in a relatively broad floodplain. An entrenched trapezoidal channel with a base width of 320 ft has been excayated ending into proteomer. trapezoidal channel with a base width of 320 ft has been excavated ending just upstream of a freeway bridge. This channel has a radius of 1,000 ft and turns approximately 80 deg in relation to the proposed channel alignment through the freeway bridge. A drop structure is to be located in the radius of the curve at the beginning of the project.
A study of the proposed project was conducted using a fixed-bed model constructed at a scale of 1:40 to study the effect of downstream waves ar disturbances caused by the curvilinear flow condi-tions. Testing of the project began with the up-stream approach and proceeded downstream to the other areas. The model study revealed that certain refinements are needed to eliminate potential prob-lems. The upstream approach as designed created an uneven distribution of flow which affected the dissipation of the drop structure. A levee ed on the left overbank area resulted in iminstalled on the left overbank area resulted in improved upstream flow conditions at discharges which would ordinarily have created flow over the left bank area. The side channel overflow spillway did not create any adverse flow conditions. This was due to low discharges coming over the spillway relative to the much larger discharge which would occur simultaneously in the Sweethers where River. Whenever the natural deposition of bed material forms a sediment buildup in the main channel. higher water-surface elevations will channel, higher water-surface elevations

result. These higher water-surface elevations will resuit. I nese ingner water-surface elevations will cause flooding along the right side of the main channel in the overflow spillway and bridge pier areas. Higher levee heights are recommended for these areas. (Lantz-PTT) W88-08419

OLD RIVER OVERBANK STRUCTURE, LOU-ISIANA: HYDRAULIC MODEL INVESTIGA-

TION,
Army Engineer Waterways Experiment Station,
Vicksburg, MS. Hydraulics Lab.
J. L. Grace, N. R. Oswalt, and E. D. Rothwell.
Available from the National Technical Information
Service, Springfield, VA. 22161. Technical Report
No. HL-88-5, March 1988. Final Report. 74 p, 7
fig, 8 tab, 30 photos, 10 plates.

Descriptors: *Scour, *Channel erosion, *Hydraulic structures, *Old River, *Louisiana, *Hydraulic models, Model studies, Riprap, Stilling basins, Flow profiles, Flow control, Spillways, Channel scour, Floods, Dikes.

Physical hydraulic model tests were conducted to rhysical hydraunic model tests were conducted to investigate the hydraulic performance of the stilling basin and evaluate riprap stability and scour potential with the existing overbank structure. Most tests were conducted in a 1:25-scale section Most tests were conducted in a 1:25-scale section model of six bays and one abutment. Other tests were conducted in a 1:44-scale section model and the existing 1:120-scale general model. The stilling basin performance and existing downstream riprap protection were adequate for head differentials of 8.0 ft or less with alternative bays fully open and fully closed (staggered gate operations). However, severe scour occurred around the pier noses immediately upstream of the structure, and the upstream riprap protection was inadequate for headwaters equal to or greater than 66.5 ft (elevations referred to the National Geodetic Vertical Datum) with a head differential of 8.0 ft. A 30-in.-thick layer of riprap (weight of the largest stone size = 1,350 lb) was required to prevent severe scour upstream of was required to prevent severe scour upstream of the structure. Controlled flow through a partially the structure. Controlled flow through a partially opened bay what modifying the existing overbank structure or riprap protection. Timber panels could be handled without modifying the existing overbank structure or riprap protection. Timber panels could be arranged to provide openings equivalent to 46.7, 31.5, and 66.7% of a fully opened bay for head differentials < or = to 13.0 ft (68.0 ft headwater elevation and 55.0 ft tailwater elevation). Controlled flow through partially opened bays with staggered timber panels was the most satisfactory manner of operating the overbank structure and, therefore, is the recommended plan. An approach dike of riprap was developed in the 1:120-scale general model for improving flow into the structure. This dike has been constructed in the prototype and performed very satisfactorily with the staggered timber panels during several flood flows in the early 1980's. (Author's abstract)

DEVELOPMENT OF LARVRINTH SPILLWAY

Mahab Ghods Consulting Engineers, Tehran (Iran). A. Afshar.

International Water Power and Dam Construction IWPCDM, Vol. 40, No. 5, p 36-39, May 1988. 4 fig, 6 ref.

Descriptors: *Spillways, *Hydrodynamics, *Dam construction, *Design criteria, *Design standards, Developing countries, Hydraulic equipment, Hydroelectric power, Civil engineering, Dams,

Spillways have a major influence on dam safety Spillways have a major influence on dam safety and their cost represents a significant part of the total project cost. Reports show that almost one third of dam failures have been caused by insufficient spillway capacities. The author describes the main characteristics of labyrinth spillways and examples illustrating the main characteristics of some existing labyrinth spillways. Labyrinth spillways can provide an economical flood-discharging structure. The design is particularly suited for use at sites where the head is limited or the spillway

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width is restricted by the topography. Compared with traditional gated spillways, a free-flow labyrinth can be more reliable. The design is also an effective means of increasing the flood discharge and storage capacity of existing dams. However, its unusual shape and complicated flow pattern have discouraged its use. Since 1970, many flume and model tests have been conducted to define the discharge coefficient curves for various labyrinth weirs. Simplicity and repetition of form make a labyrinth design and construction relatively easy, saving time and materials. (Alexander-PTT) W88-08615

SLUICE DIMENSIONING FOR DESILTING RESERVOIRS, Irrigation and Power Research Inst., Amritsar (India). T. C. Paul, and G. S. Dhillon.

International Water Power and Dam Construction IWPCDM, Vol. 40, No. 5, p 40-44, May 1988. 5

Descriptors: *Desilting reservoirs, *Large reservoirs, *Reservoirs, *Sedimentation, *Design criteria, *Design standards, Civil engineering, Guidelines, Sluices, Silting, Dams.

Experience of hydraulic flushing through low-Experience of hydraulic flushing through low-level sluices to clear reservoir sedimentation is reviewed and guidelines are presented for calculat-ing the optimum dimensions for the sluices. It is demonstrated that, although applications of the flushing technique have so far mainly been for relatively small capacity reservoirs, the technique is now proving successful in large reservoirs, for example in the USSR and China. (Author's ab-stract) stract) W88-08616

STABLE WIDTH AND DEPTH OF STRAIGHT GRAVEL RIVERS WITH HETEROGENEOUS BED MATERIALS,

Saitama Univ., Urawa (Japan). Dept. of Founda-For primary bibliographic entry see Field 2E. W88-08664

GRAVITATIONAL. OSCILLATIONS ORCILIATIONAL
OSCILIATIONS
THROUGH THE CHANNEL IN MELIDE DAM
DUE TO COUPLING OF THE LUGANO
BASINS, DIE EIGENSCHWINGUNGEN DER
DURCH DEN KANAL IM DAMM VON
MELIDE GEKOPPELTEN BECKEN DES LUCANFERGES

MELIDE GEKOPPELTEN BECKEN DES LU-GANERSES),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt füer Wasserbau, Hydrologie und Glaziologie.
J. Trosch, G. Salvade, and K. Stocker. Schweizerische Zeitschrift füer Hydrologie SZHYA6, Vol. 49, No. 1, p 16-28, 1987. 11 fig., 3 tab, 10 ref.

Descriptors: *Seiches, *Mathematical models, *Dams, *Waves, Flow discharge, Lugano, Hydrology, Water temperature, Water currents, Switzerland.

The northern and the southern ba The northern and the southern basins of Lake Lugano, Switzerland, are separated by an artificial dam. The flow of the water is not only influenced by the outflow of the northern basin into the southern basin but also by gravitational oscillations (seiches) of both basins. A long periodic peak around 100 minutes can be explained by a mathematical model. The same model indicated that the interaction of the internal waves is a coupled oscillation with a period of 74 hrs. That such interactions occur may be deduced from temperature measurements where cold water from deeper layers is sloshing through the shallow channel. A 74-hr period has been found in the data of current measurements in the northern channel. (Miller-PTT)

KARNAFULI PROJECT, MODEL STUDIES OF SPILLWAY DAMAGE, Minnesota Univ., St. Paul. Dept. of Civil and Min-

eral Engineering. C. E. Bowers, and J. Toso. Journal of Hydraulic Engineering JHEND8, Vol. 114, No. 5, p 469-483, May 1988. 14 fig, 1 tab, 7 ref,

Descriptors: *Model Studies, *Hydraulic engineering, *Hydroelectric power, *Stilling basins, *Dams, *Earth dams, *Spillways, *Flood damage, Spillway damage, Hydropower, Hydraulic jump, Karnafuli Hydroelectric Project, Fluid mechanics, Pagedelades.

Bangladesh.

In 1961, the spillway chute of the Karnafuli Hydroelectric project (Bangladesh) was damaged by flows ranging up to 3480 cms (123,000 cfs), about 20% of the design discharge. St. Anthony Falls Hydraulic Laboratory conducted model studies of the spillway. This paper illustrates the damage to the Karnafuli spillway, presents information on the probable cause of the damage, and makes brief recommendations concerning pressure fluctuations in stilling basins. The model studies indicated that fluctuating pressures in the hydraulic jump, with magnitudes up to 11 m (36 ft) of head, could have entered the 0.3 m (12 in) drain lines in the chute blocks and caused uplift of the chute slab. Logs tumbling about in the stilling basin could have caused some cracking and possibly spalling under the point of impact, but physical removal of the slabs would have required some force such as fluctuating pressures. Failure and removal of the chute slabs could have occurred by fluctuating pressures without the presence of logs. (Miller-PTT) PTT) W88-08913

EXPERIMENT ON FLUIDIZATION IN UN-BOUNDED DOMAINS, Lehigh Univ., Bethlehem, PA. Dept. of Civil En-For primary bibliographic entry see Field 2E.

NOTE ON 'INTERFACIAL MIXING IN STRATIFIED FLOWS', State Univ. of New York at Buffalo. Dept. of Civil

J. F. Atkinson.

Journal of Hydraulic Research JHYRAF, Vol. 26,
No. 1, p 27-31, 1988.1 fig, 9 ref.

Descriptors: "Hydraulics, "Model studies, "Entrainment, "Interface mixing, "Stratification, "Destratification, "Interfaces, "Mixing, "Fluid mechanics, Kinetic energy, Parametric hydrology, Hydrologic models, Molecular diffusivity, Richardson number.

A simple model was derived to explain the form of the relationship between the normalized entrain-ment rate of quiescent fluid into a turbulent mixed the relationship between the normalized entrainment rate of quiescent fluid into a turbulent mixed layer and the bulk Richardson number. The model is based on assigning parameters to the turbulent kinetic energy budget and includes the effect of molecular diffusivity through the gravity work term. Results show good agreement with available data. (Author's abstract)

LABORATORY STUDY OF PRIMARY SALINE INTRUSION IN A CIRCULAR PIPE, Dundee Univ. (Scotland). Dept. of Civil Engineer-

P. A. Davies, J. A. Charlton, and G. H. M.

Journal of Hydraulic Research JHYRAF, Vol. 26, No. 1, p 33-48, May 1988. 10 fig, 12 ref. SERC Grant GR/CO5236.

Descriptors: *Hydraulics, *Model studies, *Hydrologic models, *Saline water intrusion, *Pipes, *Outfalls, Reynolds number, Froude number,

Results are presented from a series of laboratory experiments in which the intrusion and arrest of a salt wedge in a smooth circular pipe were investigated over a range of densimetric Reynolds (es sub delta) and Froude (F sub delta) numbers. Hori-

zontal and inclined pipes were considered, in order to model intrusion in the outlet ports and tunnels of long sea outfalls. An empirical estimator expres-sion was derived to represent the functional desion was derived to represent the functional dependence of wedge length upon densimetric Reynolds and Froude numbers, respectively, and pipe slope. The agreement between the predicted wedge lengths and the measured values is generally good for a wide parameter range (Re sub delta. 7300-13200, F sub delta. 0.25-0.68) typical of prototype operation. Comparisons between the pipe data and measurements of salt wedges in open channels reveal the pitfalls of applying two dimensional results to a three dimensional configuration. (Author's abstract) thor's abstract) W88-08955

SUBCRITICAL FLOW IN RIGID-BED OPEN CHANNEL EXPANSIONS.

G. F. Nashta, and R. J. Garde. Journal of Hydraulic Research JHYRAF, Vol. 26, No. 1, p 49-65, May 1988. 14 fig, 9 ref.

Descriptors: *Streamflow, *Streambeds, *Tranquil flow, *Hydraulics, *Energy loss, *Open-channel flow, Theoretical analysis, Channel flow, Chan-nels, Expansion ratios, Energy loss coefficients, Channel expansion, Empirical equations.

The results of analytical and experimental investi-gation on subcritical flow in sudden expansion in gation on subcriticial flow in sudden expansion in rectangular rigid-bed channels with expansion ratios of 1.5 to 3.0 are presented. Data collected by other investigators were also used. Theoretically, the shape of separating stream line is predicted on the assumption that the sum of friction and expansion losses in expansion is minimal. Using the data mentioned above, velocity distribution in the vertical, distribution of mean velocity across the width, distribution of shear on the bed, lengths of the standing eddy, shape of separating streamline, and variation of energy loss coefficient have been studied. (Author's abstract)

8C. Hydraulic Machinery

SEPARABLE LINEAR ALGORITHM FOR HY-DROPOWER OPTIMIZATION, Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering. J. H. Ellis, and C. S. ReVelle.

Water Resources Bulletin WARBAQ, Vol. 24, No. 2, p 435-447, April 1988. 6 fig. 6 tab, 14 ref.

Descriptors: *Linear programming, *Hydroelectric power, Algorithms, Model studies, Computer programs, Stochastic process, Prediction, Mathematical studies, MINOS, Optimzation, Maryland.

matical studies, MINOS, Optimzation, Maryland. A deterministic, separable, linear algorithm is presented for maximizing aggregate hydropower production. The method is iterative and amenable to solution using standard linear programming software. The utility of the technique is demonstrated using several test applications involving a hypothetical single-purpose hydropower reservoir and a monthly increment 20-year flow record from the Gunpowder River in Maryland. The separable linearized forms solved quickly using Mathematical Programming System Extended (MPSX) on a variety of IBM hardware: 3090-400 VF, 3084 QX, dual processor 4381-3, and an AT/370 personal computer. For comparison purposes, the original non-linear nonseparable version of the model was also solved using MINOS. This yielded a value of aggregate hydropower marginally higher than that using MPSX. The separable, linearized methodology proved to be a useful and an efficient means of these warm starts effected substantial reductions in MINOS execution times. (Author's abstract)
W88-08052 stract) W88-08052

NORWEGIAN RIVER PROTECTION SCHEME: A REMARKABLE ACHIEVEMENT OF ENVIRONMENTAL CONSERVATION, Norges Landbrukshoegskole, Ass. Dept. of Nature

Field 8—ENGINEERING WORKS

Group 8C—Hydraulic Machinery

For primary bibliographic entry see Field 6F. W88-08230

KAPLAN TURBINES: DESIGN TRENDS IN THE LAST DECADE,
Electroconsult, Milan (Italy). Energy Dept.
A. Lugaresi, and A. Massa.
International Water Power and Dam Construction
IWPCDM, Vol. 40, No. 5, p 12-17, May 1988. 15

Descriptors: *Kaplan turbines, *Hydroelectric power, *Design criteria, *Design standards, Statis-tical methods, Mathematical studies, Civil engi-neering, Comparison studies, Turbines.

This article provides an update to the data and test results on installed Kaplan turbines published in 1977-78. As previously, the approach has been essentially statistical, based on data supplied by various manufacturers. The investigation took into account 72 units, designed, with few exceptions, after the year 1976. The research has been limited to the main parameters, such as specific speed and cavitation coefficient, and dimensions that allow for the basic unit to be selected and overall unit size to be determined. The various relationships presented here have been calculated by regression, and the results are accurate enough for a compariand the results are accurate enough for a compari-son of options for preliminary design and layout. (Author's abstract) W88-08612

NUMERICAL REFINEMENT OF PALMIET'S

PUMP-TURBINE DESIGN, Voith G.m.b.H., Heidenheim (Germany, F.R.) D. Klemm, and R. Schilling.

International Water Power and Dam Construction IWPCDM, Vol. 40, No. 5, p 17-21, May 1988. 9

Descriptors: *Turbines, *Pumps, *Pump turbines, *Numerical analysis, *Hydraulic equipment, *Hydroelectric power, *Model studies, *Design criteria, *Design standards, Civil engineering, Machineria, *Design standards, Civil engineering, Machineria natical studi

The efficiency level of two Palmiet pump-turbines was considerably improved in both modes of operation, at the design stage, by the application of numerical methods. This article describes the integrated numerical system (INS) used for the hydraulic improvement of the low specific speed pump-turbines with a head of 300 m and an output of 250 MW. Some principal results of the preliminary computations, the model test results, and the improvement of the efficiencies related to the original runner design, are shown. (Author's abstract) stract) W88-08613

EFFICIENCY SCALE EFFECTS IN PELTON

TURISINES, Sulzer-Escher Wyss Ltd., Zurich (Switzerland). H. Grein, D. Klicov, and W. Wieser. International Water Power and Dam Construction IWPCDM, Vol. 40, No. 5, p 32-36, May 1988. 8 fig, 16 ref.

Descriptors: *Scaling, *Economies of scale, *Pelton turbines, *Hydraulic equipment, Hydroelectric power, Mathematical studies, Comparison studies, Civil engineering, Flow, Comparison studies,

Comparisons of measured efficiency on model turbines and homologous prototypes may show considerable differences, which are explained as scale effects. In contrast to reaction turbines, where scaling is based on the application of resistance coefficients for pipes and plates, efficiency scaling for Pelton machines is considerably more difficult. Here, the flow pattern consists of pipe flow, free-jet flow, unsteady flow with free surface in the buckets and two-phase flow in the casing. From dimensional analysis it has become clear that, for the scaling of Pelton turbines, the specific flow rate and Reynolds, Froude and Weber numbers have to be considered. Based on comparisons of models Comparisons of measured efficiency on model tur-

and prototypes, a step-up procedure is presented which is in good agreement with full-scale test results. (Author's abstract)

8D. Soil Mechanics

SOIL MODULUS OF RUPTURE AS AFFECT-ED BY WETTING UNDER VACUUM, Agriculture and Water Resources Centre, Baghdad (Irag). R. O. Salih, A. O. Mawlood, and J. K. Kassim. Soil Science Society of America SSSDJ4, Vol. 52, No. 2, p 534-535, March-April 1988. 1 fig, 2 tab, 6

Descriptors: *Soil modulus, *Wetting, *Soil water, *Rupturing, *Soil mechanics, Hydrology, Capillarity, Soil types, Soil stability.

Effect of wetting under vacuum and by capillarity under atmospheric pressure on modulus of rupture was studied in six calcareous soils varying in texture and aggregate stability. The results showed that modulus of rupture of poorly structured soils increased by wetting under vacuum compared with wetting by capillarity under atmospheric pressure. Soils with stable structure showed the expected opposite results. Wetting under vacuum caused a decrease in specific volume of dried briquets in unstable soils and an increase in the stable soils. (Author's abstract) soils. (Author's abstract) W88-08001

SOIL-STRUCTURE INTERACTION OF FLEXI-BLE PIPE UNDER PRESSURE,

Simpson Gumpertz and Heger, Inc., Arlington,

M. S. Zarghamee, and D. B. Tigue. Transportation Research Record TRREDM, No. 1087, p 46-53, October, 1987. 8 fig, 3 tab, 15 ref.

Descriptors: *Flexibility, *Pipes, *Soil mechanics, *Durability, *Stress, *Computer programs, Backfill, Earthworks, Engineering, Model studies, Soil properties, Construction, Computer models, Deflection.

Results are presented of a finite element analysis of the soil-structure interaction of a buried flexible pipe subjected to internal pressure. The analysis was performed using a fine mesh so that (1) an accurate representation was made of the highly variable soil stiffness in some installations, similar variable soil stiffness in some installations, similar to that of a pipe with poorly supported haunches resting on a hard bedding, and (2) an accurate model was made of the pipe wall stresses in light of the rapid attenuation of local deformations and strains in flexible pipe buried in stiff soils. The nonlinear behavior of pressurized flexible pipe, including large deflections and the flexural stiffening effect of the pressure-induced membrane stresses, was also modeled. A special purpose program uses Duncan's soil model and considers the step-by-step nature of construction. It was used to calculate the stresses and strains in a buried flexible pipe with nature of construction. It was used to calculate the stresses and strains in a buried flexible pipe with improper haunch support and hard bedding. It was shown that significant flexural stresses are developed at the invert of the pipe after installation and that internal pressure magnifies the flexural stresses and strains thus developed. (Author's abstract) W88-08195

EXPERIMENTAL STUDY OF BURIED FIBER-REINFORCED PLASTIC PIPE,

REINFORCED PLASTIC PIPE, Technion - Israel Inst. of Tech., Haifa. Faculty of Agricultural Engineering. N. Galili, and I. Shmulevich. Transportation Research Record TRREDM, No. 1087, p 78-86, October, 1987. 15 fig, 3 tab, 5 ref.

Descriptors: *Pipes, *Soil mechanics, *Backfill, *Stress, *Strain measurement, *Deflection, Earthworks, Installation, Strain, Gages, Strain gages, Soil types, Soil properties, Clays, Sand.

An experimental study of interaction between soil and fiberglass-reinforced plastic pipes was per-

formed in a large laboratory soil box. Seven pipe specimens of different diameters and stiffnesses were tested at various loads and under various laying conditions. Sand and clay were the soil backfill. It was concluded that (1) soil stresses at the pipe-soil interface increase with pipe stiffness and are smaller in sand than in clay; (2) pipe deflections are reduced considerably with increasing soil modulus or degree of compaction; (3) strain distribution around flexible pipes in well-compacted backfill is mostly irregular, and maximum strains do not always occur at the crown of the pipe; (4) the thrust strains are of significant magnitude, and in more flexible pipes may reach the same order of magnitude as those due to bending; (5) poorly compacted haunches result in higher strains; and (6) split backfill of sand and clay, both well compacted, was quite successful. The importance of proper soil compaction during installation is emphasized. (Doria-PTT)

DRAINAGE SPURS ON CUT SLOPES: PRESENTATION OF DIMENSIONING CHARTS ON HYDRAULIC AND MECHANICAL CRITERIA (LES EPERONS DRAINANTS DANS LES TALUS EN DEBLAI: PRESENTATION D'ABA-QUES DE DIMENSIONNEMENT SUR CRI-TERES HYDRAULIQUES ET MECANIQUES), Nancy-1 Univ. (France)

For primary bibliographic entry see Field 4A. W88-08308

FIELD VERIFICATION OF HELP MODEL FOR LANDFILLS,
Missouri Univ.-Columbia. Dept. of Civil Engineer-

For primary bibliographic entry see Field 5E. W88-08568

REVIEW OF THE BALDWIN HILLS RESER-VOIR FAILURE,

R. B. Jansen. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 7-81, December 1987. 15 fig, 4 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Soil mechanics, *Subsidence, Baldwin Hills Dam, California, Earth dams, Geologic faults, Dam foundations, Foundations, Leakage, Seepage, Erosion, Embankments, Reservoir linings, Linings, Oil

The failure of the Baldwin Hills Dam, Los Angeles, California, on December 14, 1963, is reviewed, considering its geological setting, design and construction (completed 1951), regular surveillance program, operating history, postfailure conditions, and the influence of the nearby Inglewood oil field production and related ground movement. The reservoir emptied itself abruptly within a few hours of the discovery of muddy leakage downstream. Situated near the seismically active Newport-Inglewood uplift, the dam experienced tremors but no significant quakes. The foundation consisted of sediments susceptible to densification and crosion. The design of the 232-ft-high earthfill dam with small earth dikes on the sides included a 5 to 10-ft thick lining (asphalt and compacted earth) and a drainage system. The 24-hour surveillance program included monthly inspection, drain water sampling and flow measurement, and observation program included monthly inspection, drain water sampling and flow measurement, and observation well inspection. During initial reservoir filling cracks were discovered, necessitating repairs to the asphalt paving. Asphalt was found in the drainage until it virtually stopped in 1953. The drainage system required continued repairs, and cracks con-tinued to develop in the lining in subsequent years. After the failure inspection revealed a continuous tinued to develop in the lining in subsequent years. After the failure, inspection revealed a continuous, freshly opened east-west crack with vertical displacement of 2-7 inches, extending into the road and curb. Large sinkholes were seen. A north-south crack with little displacement was observed after several days; water had been passing through this into the earth lining. Cavities and damage were found in the drainage system. The Inglewood Oil Field adjacent to the reservoir started production in 1924 and produced 67,000 net acre-ft of oil and water up to 1963. Measurement of subsidence

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at the reservoir site showed a 3 ft change in 1917-1963 and a difference of 1/2 ft between 1947 and 1962. Surveys also showed a lateral movement toward the trough of subsidence, 0.4 ft of movement of the northeast-southwest diagonal of the reservoir between 1950 and 1963 at some stations. At one station movement was 2.2 ft between 1934 and 1961 and an additional 0.28 ft between 1941 and 1963. Many adverse forces contributed to the dam failure: horizontal and vertical displacement from subsidence, local breakage in the foundation, rebound from oil field repressurization, reservoir loading and unloading, and the final inrush of water during failure. (Cassar-PTT)

FAILURE OF BALDWIN HILLS RESERVOIR, 1963-INTERPRETATION OF STEP-BY-STEP FAILURE SEQUENCE,

T. M. Leps.
Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 83-88, December 1987. 1 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Soil mechanics, *Subsidence, *Baldwin Hills Dam, California, Earth dams, Geologic faults, Dam foundations, Foundations, Leakage, Seepage, Erosion, Embankments, Oll fields, Reservoir linings, Linings.

ings, Linings.

Observations of the Baldwin Hills Dam site in 1964 and 1969 after its failure in 1963 revealed 25 instances of open void spaces in the foundation, none of which were present at the time of construction. All were within the zones created by faults. Horizontal tension was considered the primary mechanism for the voids. The secondary mechanism was the enlargement of the planar voids in random fashion wherever flowing water found its way into pre-existing cracks. The latter occurred both very slowly and gradually over a period of years and violentily during the final break. Conclusions were as follows: (1) The underdrain system was seriously damaged by the increasing tensile strains and vertical offsets. (2) Planar voids existed along faults. (3) The asphalt lining had been ruptured in several places years before dam failure. (4) Longtime seepage caused localized erosion. (5) None of the relatively small disconnected cavities caused by slow seepage had a part in the actual destruction of the reservoir. (6) The open, through-going planar voids in the fault planes provided a highly erodible escape route for reservoir water escaping from the damaged underdrain system. (7) Subsidence was responsible for the major fault offsets which eventually destroyed the underdrain system. (Cassar-PTT) W88-08691 (Cassar-PTT) W88-08691

GROUND SUBSIDENCE ANALYSIS PRIOR TO THE BALDWIN HILLS RESERVOIR FAIL-URE.

Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 143-154, December 1987. 8 fig.

Descriptors: *Dam failure, *Geology, *Subsidence, *Reservoirs, *Soil mechanics, Baldwin Hills Dam, Long Beach Steam Station, California, Earth dams, Geologic faults, Dam foundations, Foundations, Oil fields.

The land subsidence which was responsible for failure of the Baldwin Hills Reservoir, California, was similar to the situation at the Long Beach Steam Station of Southern California Edison Company, where the yard level had dropped from 12.0 to 7.0 ft above mean lower low sea level, with a freeboard of 0.5 ft by 1946. To halt and reverse the subsidence, salt water was injected into injection wells of the nearby Terminal Island Oil Field, reducing the subsidence rate from a maximum of almost 29 inches per year in 1951 to nearly zero in 1967. Horizontal movement at the ground surface had been occurring with the vertical movement, producing damage to tunnels, pipes, walls, and pavements. It was concluded that (1) the horizonal disturbances had been caused by vertical subsidial disturbances had been caused by vertical subsidial and the surface of the control of the con pavements. It was concluded that (1) the nonzon-tal disturbances had been caused by vertical subsid-ence; (2) horizontal movement was directly pro-portional to vertical movement; (3) subsidence was directly related to the volume of oil withdrawn

from the field; and (4) faults in the oil-bearing strata had no effect on subsidence. (Cassar-PTT) W88-08692

8E. Rock Mechanics and Geology

DAMS AND EARTHQUAKES: A SHAKY RELA-

TIONSHIP, M. W. West. Civil Engineering CEWRA9, Vol. 58, No. 4, p 64-67, April 1988.

Descriptors: *Dams, *Dam design, *Earthquakes, *Project planning, *Design criteria, *Seismology, Geologic mapping, Geologic fractures, Rock mechanics, Seismic properties, Subsidence, Tectonics, Wyoming, Utah.

Wyoming, Utah.

Evidence on how earthquakes affect dams is lacking; a phased geologic assessment could help spot catastrophes waiting to happen. A recent case history illustrates many of the techniques and problems associated with seismotectonic assessment; in the early 1980s, the state of Wyoming proposed enlargement of Sulphur Creek Reservoir about 19 km southeast of Evanston, and construction of a new dam on the West Fork of the Bear River in north-central Utah. Data collected from geologic studies indicated that two major surface faulting events occurred in the last 4300 years. Based on evidence from the prehistoric earthquakes, a maximum credible earthquake of magnitude 7.5 was assigned to the Bear River fault; magnitude 7.5 earthquakes could produce peak horizontal rock accelerations of 0.6 g or more, depending on epicentral distance and attenuation. Large-magnitude earthquakes accompanied by surface faulting in the Intermountain Seismic Belt are generally accompanied by ground tilt and subsidence extending considerable distances from the zone of surface rupture; damsites located west of the Bear River fault rupture are present in the region and were assessed based on geologic mapping; tectonic fault displace. would be at risk. Hazards due to surface fault rupture are present in the region and were assessed based on geologic mapping; tectonic fault displacement at the dam site was not considered to be a credible design or safety issue. Seismotectonic hazards for project design should be treated no differently than any other design assumption; assumptions regarding hazards should be monitored over the life of the project for continuing validity and applicability. (Shidler-PTT)
W88-08143

FAULT STABILITY CHANGES INDUCED BE-NEATH A RESERVOIR WITH CYCLIC VARI-ATIONS IN WATER LEVEL, Geological Survey, Menlo Park, CA. For primary bibliographic entry see Field 6G. W88-08244

FAILURE OF TETON DAM, California Univ., Berkeley. Dept. of Civil Engi-

neering. H. B. Seed, and J. M. Duncan. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 173-205, December 1987. 22 fig. 1 tab, 11 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Teton Dam, Idaho, Earth dams, Dam foundations, Foundations, Design criteria, Erosion, Leakage, Seepage, Embankments,

The Teton Dam in Idaho failed in June 1976 during the first filling of the reservoir. An earth dam, about 300 ft high, it had a wide core zone of acolian silt supported by upstream and downstream shells consisting of sand, gravel, and cobbles. The impervious core was extended through the foundation alluvium with a 100-ft deep cut-off trench backfilled with silt. Downstream of the core was drainage zone of sand and gravels. However, no transition zone was provided between the core and the sand and gravel, nor between the impervious core and the river bed alluvium or between the key trench fill and the rock walls on the downstream side of the key trench. A grout curtain was installed, extending 1000 ft into the right abutment

and 500 ft into the left abutment. The only down-stream defense against cracking in the impervious fill or against concentrated leakage through it was the drainage zone, which did not extend into the key trenches. Two days before failure small springs were seen flowing at the riverbed level 1500 ft downstream. At 7:00 am on the day of the failure water was flowing from a point 130 ft below the crest near the junction of the embank-ment and the right abutment. Dirty water was also flowing from the talus near the toe of the embank-ment. A loud burst was noted at 10:30 am, after which seepage increased rapidly until complete failure at 11:55 am. Several lessons were evident from the failure of the Teton Dam: (1) Dam failure can occur very quickly due to internal erosion and from the failure of the Teton Dam: (1) Dam failure can occur very quickly due to internal erosion and piping. Slow filling is recommended. (2) The sealing of the core-foundation contact is essential. (3) Multiple lines of defense should be used in design. (4) Design and specifications should be changed during construction to compensate for unforceseen problems. (5) Although the wet seam in the Teton Dam was not related to the failure, this condition could cause failure in a design earthquake. (6) Dam designs should be reviewed by an independent group of engineers. (7) Instrumentation for monitoring should be installed to detect problems at an early stage. (8) Grouting is not totally effective in sealing highly jointed rock. (9) The designer should remain in contact with construction. (10) Abrupt changes in geometric configurations or material stiffnesses can lead to undesirable stress. (11) Hydraulic fracturing occurs only in the presence ternal stittnesses can lead to undesirable stress. (11)
Hydraulic fracturing occurs only in the presence
irregularities such as cracks and loose soil. (Cassar-PTT) W88-08693

TETON DAM FAILURE-A DISCUSSION, E. M. Fucik.

E. M. Pucik.
Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 207-215, December 1987. 8 fig, 1 tab.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Teton Dam, Idaho, Earth dams, Dam foundations, Foundations, Design criteria, Erosion, Leakage, Seepage, Embankments.

The wet seam discovered in the left abutment of the Teton Dam two years after its failure in 1976 points to this mechanism as the main factor in dam failure, which occurred at the right abutment. The seam in the left abutment ran the full width of the core, was 3-4 ft thick, and covered at least 5 acres. It was discontinuous and lensatic in nature. Free water was present in the seam, which contained very soft material. No explanation for the presence of the wet seam has been found. It is postulated that pressure from reservoir filling produced piping through a wet seam in the right abutment, followed by damage to the downstream shell. Evidence existed for a with him. followed by damage to the downstream shell. Evi-dence existed for a wet horizon at the right abutment, but it was not possible to determine if this condition existed before failure. A possible link with activities during the winter shutdown of 1974-75 was proposed, but no evidence was obtained to substantiate this. (Cassar-PTT)

TETON INVESTIGATION-A REVIEW OF EX-ISTING FINDINGS,

A. D. M. Penman. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 221-237, December 1987. 4 fig, 19 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Teton Dam, Idaho, Earth dams, Dam foundations, Foundations, Design criteria, Erosion, Leakage, Seepage, Embankments, Grouting, Geologic fractures.

Review of reports on the Teton Dam failure result-ed in the following conclusions. The site was un-suitable because the volcanic rock is very permea-ble and full of cracks and joints of apparently random orientation. A trial grouting program dem-onstrated the extent of the fractures and fissures. onstrated the extent of the fractures and insurers Grouting was done at the contact zone between core and abutment up to a level of 47 ft above streambed, and silt was used to fill the many small fissures above this height. The concept of a narrow

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cut-off trench through this zone with the idea of forming a seal with highly erodible silt was an aberration in engineering judgment. The regional water table at the site was so low that a great deal of water could escape into the downstream rock without raising the water table to ground level, producing visible springs. The Teton Dam had few piezometers or observation holes that could be used in monitoring the groundwater rise with reservoir filling. No instruments were available for making hydraulic fracture tests or measuring pore pressures during construction. Hydraulic fracture tests with drilled h holes showed that the minimum principal stress in the cut-off trench was about 30% less than that at corresponding depth in the main core: an indication of weight transfer from the core to the trench walls. In the core small the core to the trench walls. In the core small variations in the silt caused some layers to be slightly less dense and more pervious in spite of careful construction and inspection; some of these layers developed positive pore pressures under the overburden of the completed dam. The reason that failure did not originate at the left abutment was because the fill was wet during construction and because there appeared to be less fissuring in the bedrock. (Cassar-PTT)

LESSONS FROM THE TETON DAM FAILURE, For primary bibliographic entry see Field 8A. W88-08696

MALPASSET DAM FAILURE,

Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 295-329, December 1987. 27 fig, 7 ref, append.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Malpasset Dam, France, Design criteria, Arch dams, Concrete, Dam foun-dations, Foundations, Geologic fissures, Hydro-static pressure, Permeability, Pore pressure.

The Malpasset Dam in southern France was designed as a pure double curvature arch, maximum height 60 ft. The dam failed explosively at night in December 1959 with no witnesses in the immediate December 1959 with no witnesses in the immediate vicinity. No abnormal signs had been detected a few hours before the event. Little of the arch remained, and the rock foundation of the left bank remained, and the rock foundation of the left bank was cut by a deep trough. Back-analysis of the failure did not reveal any information on the mechanisms responsible for the destruction. These included concrete stress analysis, buckling of the arch, siting of the abument block, sliding of the dam at the contact with rock, and sliding on the downstream fault. A possible explanation for the dam failure involves the geology of the rock foundation. On the left bank the arch thrust (almost parallel to the foliation) was unable to spread out. parallel to the foliation) was unable to spread out as it penetrated into the bank, but remained concentrated in a section of ground reaching the downstream fault. This block was subjected to the downstream fault. This block was subjected to the arch thrust and the direct water load on the face of the underground dam. Under increasing load of rising water behind the arch, the upward movement increased and caused rupture of the rock mass followed immediately by the explosive phase. The arch separated from its foundation and rotated as a whole about its upper right end. The whole left side of the dam collapsed, followed by the middle part of the dam, then the right supports. Although a drainage system (absent at this dam) would not have alleviated the underground pressure upstream of the water-tight barrier, it might have acted as a monitoring device. (Cassar-PTT) W88-08697

MALPASSET DAM FAILURE, Laboratoire de Mecanique des Solides, Palaiseau (France). nary bibliographic entry see Field 8A.

LATEST THINKING ON THE MALPASSET ACCIDENT, G. Post, and D. Bonazzi.

Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 339-353, December 1987. 9 fig, 3 ref, append.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Abutments, *Malpasset Dam, France, Arch dams, Concrete, Dam foundations, Foundations, Hydrostatic pressure, Model studies,

Two additional points concerning the failure of the Malpasset Dam are presented. Andre Coyne, the well-respected designer of the dam, believed that an arch dam is the safest of all structures but warned against weaknesses in the abutments. When the dam was constructed in the 1950s, it was not common reaction to exchange the safe of the safe common practice to methodically survey founda-tion rock structure in depth. Neither was it realized how the mechanical effects of water under presnow the mechanical effects of water under pres-sure seeping into the foundation through cracks caused by the dam itself could affect the upstream side of the abutments. In a study of 17 French dams Malpasset was classified as having the most deformable rock in the foundation. In a graph depicting heel cracking vs. dam height, Malpasset is intermediate; however, no boundaries of feasibil-ity for arch dams are shown. A minimum elastic modulus for a rock suitable for an arch dam of low modulus for a rock suitable for the action and or moderate height should be 3000-6000 MPa, more for very high arch dams. It is believed that the elastic modulus of the left-bank rock at Malpasset was 500-1000 MPa. (Cassar-PTT) W88-08699

MALPASSET DAM DISCUSSION-REMEM-BRANCES OF FAILURES OF DAMS, Coimbra Univ. (Portugal). Seccao Autonoma de Engenharia Civil. J. L. Serafim.

Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 355-366, December 1987. 15 fig, 12 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Malpasset Dam, France, Design criteria, Arch dams, Concrete dams, Dam foundations, Foundations, Seopage, Hydrostatic pressure, Permeability, Pore pressure, Stress.

The failure of the Malpasset Dam in France was The failure of the Malpasset Dam in France was caused by the following: (1) lack of shear strength in a surface along the left bank of the foundation, (2) excessive uplift in the foundation due to the lack of drainage, (3) high tensile stress in the elastic body which started to produce cracks upstream and then downstream, (4) less than ideal vertical and horizontal shape. The failure of the concrete took place by tension perpendicular to the isostatics of compression in the rock blocks. Major causes of failure of concrete and masonry dams include (1) lack of shear strengths in the foundations. include (1) lack of shear strengths in the founda-tion, especially in weak planes of dangerous orien-tation (Malpasset), (2) excessive uplift in the foun-dation or in a foundation block, usually due to dation or in a foundation block, usually due to defective drainage (Malpasset, Gleno, Busey), (3) lack of strength in the dam body (Chikkahole Dam in India, Vega de Tera in Spain), (4) ahnormal deformability or very directional permeability of the foundation, (Vega de Tera), (5) piping and erosion of the foundation due to excessive permeability of soil (Puentes Dam in Spain), (6) erosion downstream caused by overtopping (Khadakwasha downstream caused by overtopping (Khadakwasha Dam in India and Lanier and Moyie in the U.S.), and (7) defective design and construction. (Cassar-PTT) W88-08700

MODIFIED HYPOTHESIS FOR FAILURE OF MALPASSET DAM,

Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Grundbau, Boden chanik, Felsmechanik und Verkehrswasserbau. W. Wittke, and G. A. Leonards.

Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 367-394, December 1987. 33 fig. 10 ref.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Malpasset Dam, France, Design criteria, Arch dams, Concrete dams, Dam foundations, Foundations, Seepage, Hydrostatic pressure, Model studies, Permeability, Pore pressure, Stress, Abutments, Drainage systems.

A mathematical analysis was applied to the Mal-passet Dam failure. Analyses showed that, for full storage, as a consequence of water pressure on the

upstream face of the dam and seepage pressure exerted on the foundation, tensile stresses perpendicular to the schistosity developed on the upstream side of the left abutment, leading to cracking of the rock. Consequently, the permeability of the cracked zone was larger than that of the undisturbed rock, causing a redistribution of equipotentials and an unfavorable loading of the left abutment by seepage pressure. Compared with the explanation given by Bellier and Londe, the mechanisms of failure were the same, but the rock mechanics reasons differed. Measures which could increase dam stability in a Malpasset-type construction include an appropriate dam shape and foundation width and installation of a grout curtain and drainage system inclined toward the upstream side. (Cassar-PTT) upstream face of the dam and seepage pressure

MALPASSET DAM,

Coyne et Bellier, Paris (France). G. Post, and D. Bonazzi. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 395-398, December 1987. 3 fig.

Descriptors: *Dam failure, *Geology, *Reservoirs, *Rock mechanics, *Malpasset Dam, France, Arch dams, Concrete dams, Dam foundations, Foundations, Seepage, Hydrostatic pressure.

Calculations concerning the Malpasset Dam failure showed that the upstream plane sheared over most of its surface with an upward movement. Downstream of the area under direct dam loading the thrust block was overloaded. It is most likely that the thrust block yielded before any general movement of the abutment. The cause of this was probably the combination of deformability and bedding, the downstream fault playing only an ancillary role in the process. (Cassar-PTT) W88-08702

VAJONT CATASTROPHE-A PERSONAL

L. Muller-Salzburg. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 423-444, December 1987. 7 fig, 24 ref.

Descriptors: *Dam failure, *Rock mechanics, *Geology, *Reservoirs, *Landslides, *Slope stability, *Vajont Dam, Italy, Disasters, Arch dams, Con-

crete dams.

The Vajont Dam in northern Italy was a doubly-arched, 276-m-high dam, featuring a concrete grade slab separated form the dam by a perimetral joint. Construction was 1957-1960, and filling was carried out in steps with careful monitoring because of slope instability noticed during the early stages of impoundment. The catastrophe occurred on October 9, 1963, at 22h39 after the reservoir level had been lowered 10 m. At this time the reservoir was 2/3 full. The southern rock slope of the canyon failed suddenly, with no warning, over a length of 2 km and a slide surface of 2 sq km was thrust onto the right bank only 50 m upstream of the dam crest. The mass of displaced water flooded the northern slope and spilled over the dam crest in a thickness of 245 m, destroying several towns and killing 1925 people. Although the slide occurred suddenly, it was not unexpected. Many minor slope failures and significant displacement had occurred during the three years of filling. The small slides were well documented; and the actual failure was estimated at about 25 m per second. The configuration of the failure surface was disinctly easy chair-shaped. Researchers have not agreed on the mechanism of the slope failures. Some theories include a prehistoric slide surface, artesian pressures in the slide mass, and unexpectedly low friction values. Back-calculations produced widely differing results. (Cassar-PTT) W88-08703 W88-08703

VAJONT SLIDE: INSTRUMENTATION--PAST EXPERIENCE AND THE MODERN AP-PROACH.

. G. Belloni, and R. Stefani Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 445-474, December 1987. 14 fig, 29 ref.

Descriptors: *Dam failure, *Rock mechanics, *Measuring instruments, *Geology, *Reservoirs, *Landslides, *Slope stability, *Vajont Dam, Italy, Disasters, Arch dams, Monitoring.

Monitoring (boreholes, piezometers, surface monu-ments) was conducted during the filling of the Vajont reservoir, which was prone to frequent rockslides into the water. In 1959 doubts were raised about the stability of the slope. When the water level reached 40% of total height after water level reached 40% of total height after almost a year of filling, a large zone was slowly moving downward, influenced by water movement. Most engineers agreed that movement would continue, but it would be controlled by filling and emptying the reservoir. In 1959-1960 five slides or appearances of cracks were documented, prompting installation of additional monitoring equipment and a lowering of the water level. Four piezometers were installed in the spring of 1961, but information obtained from them was not too meaningful due to poor installation and lack of consideration of rainfall data. Although devices were positioned to measure slide movement, results were interpreted in a general way, with not much attention paid to the vertical movement. Several small seismic events were recorded, with not much attention paid to the vertical movement. Several small seismic events were recorded, but there was no attempt to relate the seismicity with the mechanics of the slope movement. Several additional instances of cracks and minor failure preceded the major slide on October 9, 1963. A scenario for instrumentation and reservoir filling is proposed, using a modern approach. Knowledge gained from such a study would suggest two solutions: (1) continue raising the reservoir level, accompanied by monitoring and mathematical modeling, and (2) (the preferred solution) carry out remedial measures and then raise the reservoir. Remedial measures would include control of pore pressure by drainage and strengthening the rock remental measures would include cointrol to porter by drainage and strengthening the rock mass. Then the reservoir would be filled to its maximum under fully controlled conditions, with small lowerings and continued remedial works. Again the reservoir would be lowered to the minismall lowerings and continued remedial works. Again the reservoir would be lowered to the minimum and all remedial measures revised in their final form, after which the hydroelectric scheme could be used at full capacity. The slope instrumentation system would stay in place to serve as a warning system. (Cassar-PTT)

VAJONT SLIDE-A GEOTECHNICAL ANALY-SIS BASED ON NEW GEOLOGIC OBSERVA-TIONS OF THE FAILURE SURFACE, Illinois Univ. at Urbana-Champaign. Dept. of Civil

A. J. Hendron, and F. D. Patton Engineering Goolean B. A. J. Hendron, and F. D. Fatton. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 475-491, December 1987. 5 fig. U.S. Army Engi-neer Waterways Experiment Station Contract No. neer Waterways Experin DACW39-79-C-0063.

Descriptors: *Dam failure, *Rock mechanics, *Geology, *Reservoirs, *Landslides, *Slope stability, *Vajont Dam, Italy, Disasters, Arch dams, Clays.

The landslide at the Vajont reservoir was a reactivation of an old slide, probably dating to postglacial times, but before recorded history. Evidence for this is strong and diverse, including the surface morphology and the talus infilling of a recurring crack. The slide mass moved on clay layers which were continuous over large areas of the surface of sliding. The failure surfaces of the 1963 slide and the prehistoric slides seem to correspond closely to faults of possible tectonic origin formed in much earlier geologic times. Most of the slide mass moved as a unit. A secondary slide movement was presumably triggered by the loss of toe support caused by the movement of the main slide. In the mountain above the reservoir conditions existed caused by the movement of the main slide. In the mountain above the reservoir conditions existed which enabled the transmission of high water pressures developed from infiltration of precipitation and snowment. An inclined multiple-layer artesian aquifer system was present at and below the surface of sliding. Stability analyses showed that about 40% of the total shearing resistance acting on the slide mass was supplied by near-vertical faces which formed the eastern boundary of the slide. The amount of 30-day rainfall capable of

producing slope failure without the presence of a reservoir is 700 mm. This amount was very likely exceeded during the four years of reservoir filling, since the monthly rainfall average was almost 500 mm. Therefore, significant movements must have occurred without the influence of the reservoir. With the reservoir at its design level, a slide could have occurred without rainfall. Evidence shows that gaps in data about the Vajont monitoring existed: lack of substantive water pressure data and lack of reliable movement records along the failure plane. Subsurface borehole deformation measurements would have indicated the failure plane, and the slide could have been stabilized by drainage. (Cassar-PIT) (Cassar-PTT) W88-08705

VAJONT RESERVOIR SLOPE FAILURE, E. Nonveiller. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 493-512, December 1987. 10 fig. 3 tab, 29 ref.

Descriptors: *Dam failure, *Rock mechanics, *Geology, *Reservoirs, *Landslides, *Slope stability, *Vajont Dam, Italy, Disasters, Arch dams, Moni-

The Vajont reservoir slide occurred on a slope in a geologically very young, deeply eroded valley with evident signs of geologic instability. The uplift caused by submerging large volumes of rock material due to rising lake level was being balanced by increasing shear stresses that started or enhanced an existing process of progressive failure. When the available shear resistance balanced the stresses, the slide accelerated. As frictional heat further reduced the shear resistance, the motion accelerated to a high velocity. Modern instrumentation and interpretation of the data obtained from it would give a clear picture of the depth of the failure plane and of the character of the process. However, it might be difficult to assess the real potential of danger. The large slide in 1960 might have served as a caution to limit the water level to an elevation of 650 m, a level which would have impaired operation but may have avoided the tragedy of 1963. (Cassar-PTT)

VAJONT SLIDE.

L. Muller-Salzburg. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 513-523, December 1987. 4 tab, 27 ref.

Descriptors: *Dam failure, *Rock mechanics, *Geology, *Reservoirs, *Landslides, *Slope stability, *Vajont Dam, Italy, Disasters, Arch dams, Stress, Water pressure, Groundwater level.

Water pressure, Groundwater level.

The background and chronology of the Vajont reservoir slide are reviewed by one, who was involved with the foundation construction and reinforcement of the abutment. Upon inspection of the half-built reservoir, he suspected that slides would occur. Immediately investigations on slope stability were started. However, one report indicated that slides were likely to be initiated by reservoir filling, and another report claimed that only superficial slides were likely. Although measurements indicated that a rock mass of 200 million cu m was moving, it was not taken seriously by some experts. As a result, it was too late to carry out drainage measures. It was not recognized that changes in shear resistance could be mobilized in some parts of the slide but not in others. The groundwater table was measured, but its influence on the mechanics of the slide was ignored. Although detailed geologic exploration was done on the mechanics of the slide was ignored. Although detailed geologic exploration was done before the major slide, no measurements were made to determine exactly how deep the sliding surface was. Instrumentation for early warning was not in place. Geological facts concerning the clay layers and the existence of a prehistoric slide were known but not accepted. Also not considered were the initial stresses, the groundwater level, and artesian water pressure. It was predicted that a rock slide would produce a wave of no higher than 26 meters over the dam crest. Therefore, the water level would be maintained accordingly. This was one of several decisions which were wrong in principle. A list of circumstances under which a

slide would not have caused a catastrophe is given. It includes accurate prediction of the aliding velocity, more freeboard, and better prediction of the drastic wave height. (Cassar-PTT) W88-08707

ASPECTS OF THE VAJONT SLIDE, Wollongong Univ. (Australia). Dept. of Civil and Mining Engineering. R. N. Chowdhury. Engineering Geology EGGOAO, Vol. 24, No. 1-4, p 533-540, December 1987. 6 ref.

Descriptors: *Dam failure, *Rock mechanics, *Geology, *Reservoirs, *Landalides, *Slope stability, *Vajont Dam, Italy, Disasters, Arch dams, Pore pressure, Clays, Stress.

The uncertainties concerning the conditions at the site of the rock slide at the Vajont reservoir (a) before the movements began and (b) at the instant the major event of October 9, 1963 took place are highlighted. It is not known what percentage of the failure surface may have cut across clay interbeds in different sections. It is likely that some terbeds in different sections. It is likely that some sections of the alip surface may have passed through clays with significantly higher residual shear strength than others. Pore water pressures along the slip surface at the time of failure are not accurately known. Existing data relies on only one piezometer, and serious doubts exist about its method of installation and sealing. The relationship of antecedent rainfall and the reservoir level on the pore pressures is not clear. Conditions assumed for stability analysis are also questionable. Even if the most important assumptions (prehistoric landslide site, extensive clay layers, and no healing at the prehistoric iste) are agreed upon, considerable uncertainty about the precise conditions for the occurrence of the landslide exist. Little attention has been given to the initial stress conditions at the site been given to the initial stress conditions at the site of the slide. The proposed phenomenon of porfulid vaporization leading to high pore pressures and high velocities after failure is difficult to accept. Whereas some authors state that the rock mass moved as a block, it is likely that changes in stress distribution, load transfer, and redistribution of stress must have occurred. In spite of incomplete understanding of this event, it is still possible to learn practical lessons. (Cassar-PTT) W88-08708

8F. Concrete

DESIGN RECOMMENDATIONS FOR REIN-FORCED CONCRETE CYLINDRICAL STOR-

ALS, Guelph Univ. (Ontario). School of Engineering. J. C. Jofriet, R. Green, and T. I. Campbell. Canadian Journal of Civil Engineering CICEB8, Vol. 14, No. 4, p 542-549, August, 1987. 3 fig. 1 bb 26 ref. annend.

Descriptors: *Concretes, *Concrete technology, *Water tanks, *Water storage, *Design criteria, *Mechanical failure, Engineering, Standards, Design standards, Reservoirs, Stress, Tensile stress, Rheology, Cracks, Temperature gradient, Col-

Three design criteria were developed for cylindrical, non-prestressed concrete storage structures in Ontario. The first limits the circumferential tensile stress in the concrete from lateral wall pressure, shrinkage, and temperature gradients in the wall. The second is concerned with the tension in the hoop reinforcement and guards against collapse. The third limits the crack widths of the cracked concrete section. The most important design loads are discussed, and maximum values for hoop tension are provided for liquid pressures. A design temperature gradient of 15 C is recommended for design in southern Ontario, and appropriate values for shrinkage tensile stress are suggested. The collapse limit state criterion must be evaluated for the hoop steel stresses due to the lateral wall loads. The limit state criterion related to the hoop tensile stress in the concrete must be investigated for all possible load combinations of lateral wall load, Three design criteria were developed for cylindri-

Group 8F—Concrete

shrinkage, and temperature gradients. Recommendations are made for reasonable load factors, the tensile strength of the concrete, and appropriate strength factors. (Author's abstract)

W88-08211

8G. Materials

FIELD PERFORMANCE OF CORRUGATED POLYETHYLENE PIPE CULVERTS IN OHIO, Ohio Dept. of Transportation, Columbus. J. O. Hurd.

Transportation Research Record TRREDM, No. 1087, p 1-6, October, 1987. 9 fig, 14 ref.

Descriptors: *Culverts, *Pipes, *Pipelines, *Ohio, Inspection, Durability, Backfill, Earthworks, Flow, Engineering, Structural engineering, Hydraulic structures, Plastics, Polymers, Hydrogen ion concentration, Mechanical failure, Field tests,

A total of 172 corrugated polyethylene pipe cul-verts ranging in age from 0 to 4 years were in-spected in Ohio in the summer of 1985. Data relating to structural performance and durability relating to structural performance and durability were collected at each site. These data were pipe diameter, cover over the pipe, type of backfil, culvert age, average daily traffic, pipe deflection, flow depth and velocity, bed load depth and size, water pH, and pipe slope. No culvert showed any signs of wear even at sites with abrasive flow. One 4-year-old site had constant low pH dry weather flow with a bed load of large cobbles. The incidence of large maximum deflections or wall flattening and buckling, or both, was significantly greater for 12- and 15-in. pipes than for 18- and 24-in. pipes. Instances of wall flattening or buckling were limited to the 12- and 15-in. culverts. Large deflections, flattening, and buckling were generally deflections, flattening, and buckling were generally due to bending of the pipe wall in both the circumstrential and longitudinal directions. The greater flexibility and thinner walls of the 12- and 15-in. culverts were the only apparent reasons for the difference in performance. (Author's abstract) WRR-08192

EVALUATION OF METAL DRAINAGE PIPE DURABILITY AFFER TEN YEARS, Louisiana Dept. of Transportation and Develop-ment, Baton Rouge. Research and Development

For primary bibliographic entry see Field 8A.

ABRASION RESISTANCE OF ALUMINUM CULVERT BASED ON LONG-TERM FIELD PERFORMANCE,

Keopf and Lange, Inc., Lafayette, CA.
A. H. Koepf, and P. H. Ryan.
Transportation Research Record TRREDM, No.
1087, p 15-25, October, 1987. 13 fig. 3 tab, 5 ref.

Descriptors: *Aluminum, *Abrasion, *Durability, *Culverts, *Field tests, Inspection, Pipes, Pipelines, Backfill, Performance evaluation, Earthworks, Hydraulic structures, Mechanical failure, Engineering, Structural engineering, Energy, Installation.

A study was performed on aluminum culvert that A study was performed on aluminum culvert hat averaged 20 years of exposure to abrasion, based on the methods and results of a 1968 study of culvert exposed to abrasion for from 4 to 7 years. The original study proposed a form of energy level for bed load materials and rated abrasion performance through a series of energy ratings. The energy level and abrasion predictions were compared with field experience, showing that long-term culvert abrasion can be predicted when culvert geometry, installation arrangement, and content of bed load materials are established. In the vert geometry, installation arrangement, and con-tent of bed load materials are established. In the current (1984-1985) study, the basic method of determining abrasion levels was retained and sim-plified to emphasize key variables. Results showed that abrasion followed the pattern of the previous work. Long-life abrasion typically does not contin-ue at a linear wastage rate but levels off to a much reduced rate, reflecting reductions in total energy

as the flow channel stabilizes with age. Abrasion and service life for aluminum culvert inverts may be predicted as a function of water flow, culvert entrance arrangement, culvert slope, and rock content of streambed load. (Doria-PTT) W88-08194

SOIL-STRUCTURE INTERACTION OF FLEXI-BLE PIPE UNDER PRESSURE, Simpson Gumpertz and Heger, Inc., Arlington, MA.

For primary bibliographic entry see Field 8D. W88-08195

EXPERIMENTAL STUDY OF BURIED FIBER-REINFORCED PLASTIC PIPE, Technion - Israel Inst. of Tech., Haifa. Faculty of Agricultural Engineering.
For primary bibliographic entry see Field 8D.
W88-08196

BAMBOO AND WOODEN PIPES, For primary bibliographic entry see Field 5F. W88-08228

CRITICAL REVIEW OF CEMENT BASE STA-BILIZATION/SOLIDIFICATION TECH-NIQUES FOR THE DISPOSAL OF HAZARD-OUS WASTES.

Clark (A.) and Associates, Twickenham (England). For primary bibliographic entry see Field 5E. W88-08410

81. Fisheries Engineering

FISHERIES IN MAN-MADE POOLS BELOW GRADE-CONTROL STRUCTURES AND IN NATURALLY OCCURRING SCOUR HOLES OF UNSTABLE STREAMS,

Agricultural Research Service, Oxford, MS. Sedimentation Lab.

C. M. Cooper, and S. S. Knight. Journal of Soil and Water Conservation JSWCA3, Vol. 42, No. 5, p 370-373, September-October 1987. 3 fig, 2 tab, 5 ref.

Descriptors: *Fisheries, *Fish ponds, *Fish management, *Scour holes, *Streams, Yazoo River Basin, Mississippi, Ecological distribution, Rotenone sampling.

none sampling.

As part of the ecological research on high gradient streams in the Yazoo River Basin of Mississippi, 4 man-made pools below grade-control (low-drop) structures and 4 naturally occurring soour-hole pools were sampled for fish composition by the rotenone method. Tillatoba and Long Creeks were chosen because of the presence of grade-control structures used as structural management practices for control of channel erosion from head cutting and because the region has been included in as comprehensive land treatment and channel stability project. Differences in the fisheries characteristics of the two pool habitats were expected because of differences in their relative stability, bottom substrate, and pool life expectancy. Natural scour holes yielded 0.06 kg/cu m were considered harvestable. Twenty-nine species in man-made pools yielded 0.06 kg/cu m, with 0.025 kg/cu m being harvestable. Length frequency distribution indicated that there was better growth of many species and more stable reproducing populations of forage fish in man-made pools, although they yielded somewhat fewer species. While such pools will not support heavy sport fishing pressure, drop structure pools have several advantages over most natural scour rewer species. Write such pools will not support heavy sport fishing pressure, drop structure pools have several advantages over most natural scour holes in their fisheries characteristics. They also offer protection from stream channel degradation while providing additional habitat diversity. (Au-thor's abstract) W88-08384

FISH SPECIES ASSEMBLAGES IN SOUTH-WESTERN WISCONSIN STREAMS WITH IM-PLICATIONS FOR SMALLMOUTH BASS MANAGEMENT,

Wisconsin Dept. of Natural Resources, Madison. For primary bibliographic entry see Field 2H. W88-08425

RECRUITMENT DYNAMICS OF METAMOR-PHOSING ENGLISH SOLE, PAROPHRYS VE-TULUS, TO YAQUINA BAY, OREGON, Oregon State Univ., Corvallis. Coll. of Oceanogra-

phy. For primary bibliographic entry see Field 2L.

WHITEFISH (COREGONUS LAVARETUS (L.))
OF THE WAHNBACH RESERVOIR AND
THEIR ASSESSMENT BY HYDROACOUSTIC
METHODS,

Landesanstalt fuer Fischerei Nordrhein-Westfalen, Kirchhundem (Germany, F.R.).

T. Brenner, J. Clasen, K. Lange, and T. Lindem. Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 3, p 363-372, 1987. 6 fig, 4 tab, 15 ref.

Descriptors: *Whitefish, *Fish management, *Reservoirs, *Wahnbach Reservoir, *Population dynamics, *Predation, Zooplankton, Acoustics, Data acquisition, Germany, Drinking water.

acquisition, Germany, Drinking water.

In 1957, whitefish were successfully introduced into Wahnbach reservoir, a drinking water storage near Bonn (FRG). Since excessive predation on the herbivorous zooplankton by fish could have negative effects on water quality, the size of the pelagic fish stock had to be known. For this purpose, and for establishing management guidelines for the whitefish population, a stock assessment involving hydroacoustics, trawling and gillnetting was performed in October 1984. The results indicate that the whitefish stock is self-sustaining. Growth of individual fish is moderate. The total pelagic fish population was estimated to be 11,130 fish, comprising some 2600 whitefish larger than 25 cm. Stock density was low. An annual catch of about 900 adult whitefish (300 kg or 1.4 kg/ha) is recommended in order to control population size and to limit predation pressure on herbivorous zooplankton. (Author's abstract) W88-08834

RECYCLING OF THE AQUATIC WEED, WATER HYACINTH, AND ANIMAL WASTES IN THE REARING OF INDIAN MAJOR CARPS

Central Inst. of Freshwater Aquaculture, Bhuba eswar (India).

B. K. Mishra, A. K. Sahu, and K. C. Pani. Aquaculture AQCLAL, Vol. 68, No. 1, p 59-64, January 1988. 2 tab, 19 ref.

Descriptors: *Waste recovery, *Carp, *Aquaculture, *Recycling, *Animal wastes, *Aquatic plants, *Water hyacinth, *Fish hatcheries, *Biomass, Waste disposal, Performance evaluation, Fish,

The efficacy of recycling cattle wastes and the aquatic weed, water hyacinth, in the rearing ponds for Indian major carps was studied. No other input was provided. It was observed that addition of the weed alone (treatment A) increased fish production by about \$20% as compared to the control (D). weed alone (treatment A) increased fish production by about 52% as compared to the control (D) with no input. A combination of cattleshed washings and biogas slurry (treatment B) increased fish production by about 126% as compared to the control. A combined treatment with biogas slurry, cattleshed washings and water hyacinth (treatment C) gave the maximum production, about 170% higher than the control. The average gross/net productions obtained after one year of rearing for treatments A, B, C and D were 945/794.8, 1409.5/1238.05, 1679/1526.1 and 622/494.45 Kg/ha/yr respectively. (Author's abstract) spectively. (Author's abstract) W88-08851

EFFECTS OF WATER TEMPERATURE ON FEEDING AND SURVIVAL OF RIGHTEYE FLOUNDERS LIMANDA HERZENSTEINI

SCIENTIFIC AND TECHNICAL INFORMATION—Field 10

Preparation Of Reviews—Group 10F

AND LIMANDA YOKOHAMAE, (IN JAPANESE), Hokkaido Univ., Hakodate (Japan). Faculty of For primary bibliographic entry see Field 2L. W88-08887

SCREENING OF BACTERIA WITH ANTI-VIRAL ACTIVITY AGAINST INFECTIOUS HE-MATOPOIETIC NECROSIS VIRUS (IHNV) FROM ESTUARINE AND MARINE ENVIRON-MENTS, Hokkaido Univ., Hakodate (Japan). Faculty of

Fisheries.
For primary bibliographic entry see Field 2L.
W88-08888

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information **Center Services**

DEVELOPMENT OF AN ENVIRONMENTAL DATA BASE FOR RIVERS, LAKES, AND RESERVOIRS,

Environmental Monitoring Systems Lab., Las Vegas, NV. For primary bibliographic entry see Field 7C. W88-08295

10F. Preparation Of Reviews

HYDROLOGY OF ALASKAN WETLANDS, U.S.A.: A REVIEW, Cornell Univ., Ithaca, NY. Ecosystems Research Center. For primary bibliographic entry see Field 2H. W88-08025

REMOVAL OF PHOSPHORUS DURING WASTEWATER TREATMENT: A REVIEW, Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering. For primary bibliographic entry see Field 5D. W88-08198

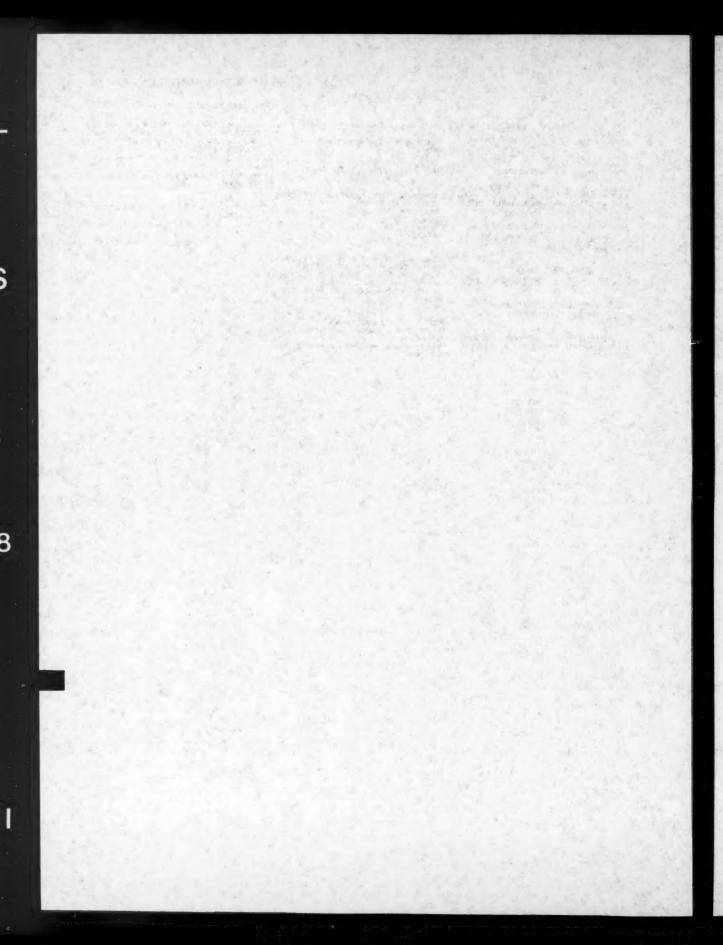
REVIEW OF SOIL SOLUTION SAMPLERS, Colorado Univ., Boulder. Inst. of Arctic and Alpine Research. For primary bibliographic entry see Field 7B. W88-08666 TEMPERATURE EFFECTS ON PHOTOSYN-THETIC CAPACITY, RESPIRATION, AND GROWTH RATES OF BLOOM-FORMING CYANOBACTERIA, National Inst. for Water Research, Pretoria (South

Africa).

For primary bibliographic entry see Field 2H. W88-08767

EFFECTS OF METALS ON FISH BEHAVIOR: A REVIEW Iowa State Univ., Ames. Dept. of Animal Ecolo-

For primary bibliographic entry see Field 5C. W88-08783



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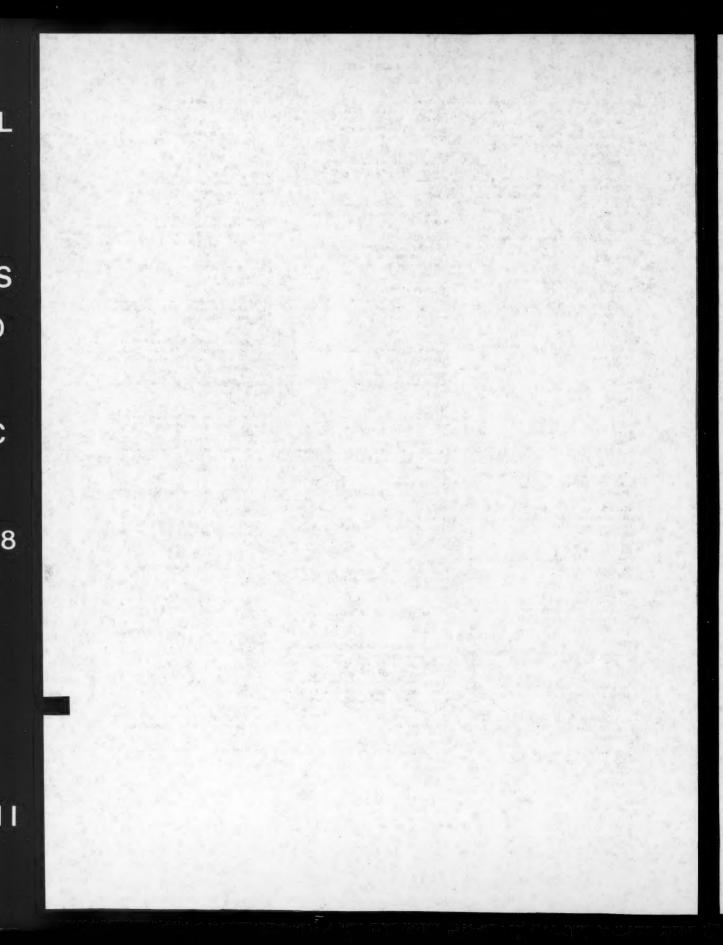
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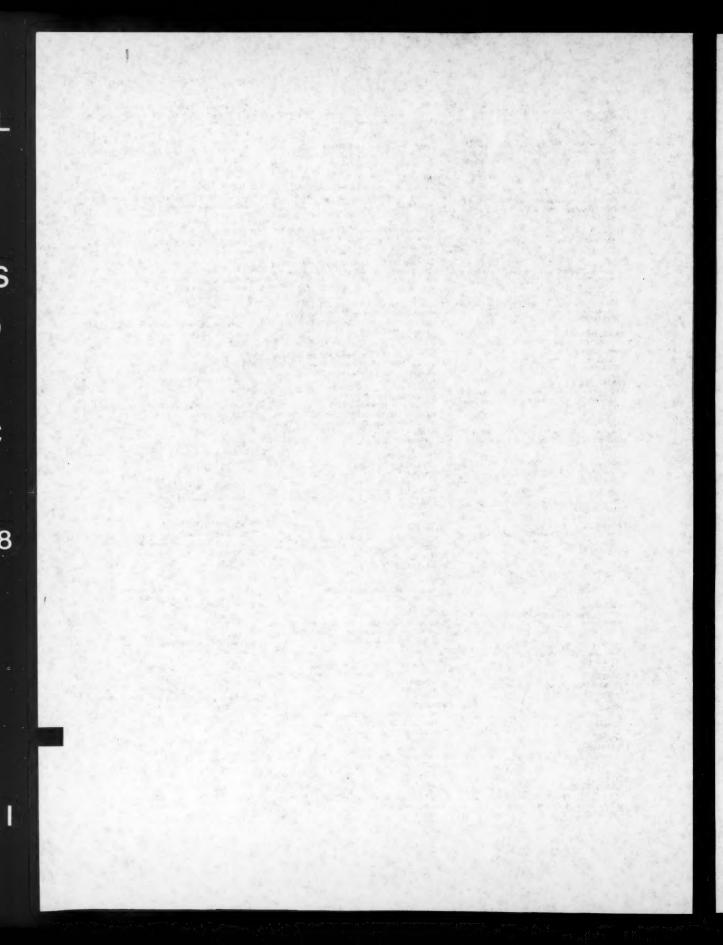
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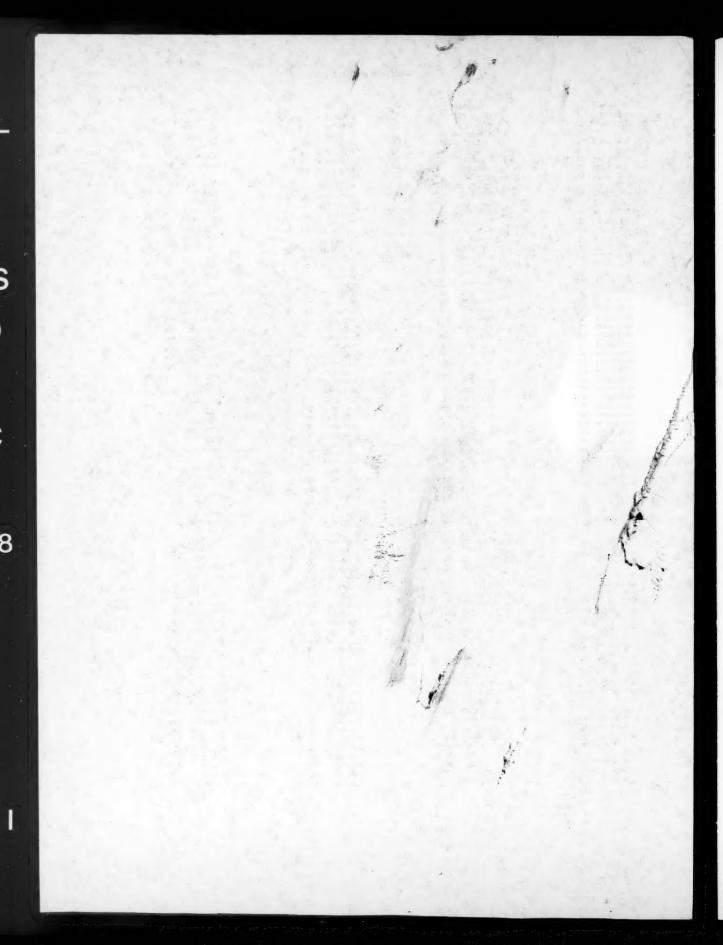
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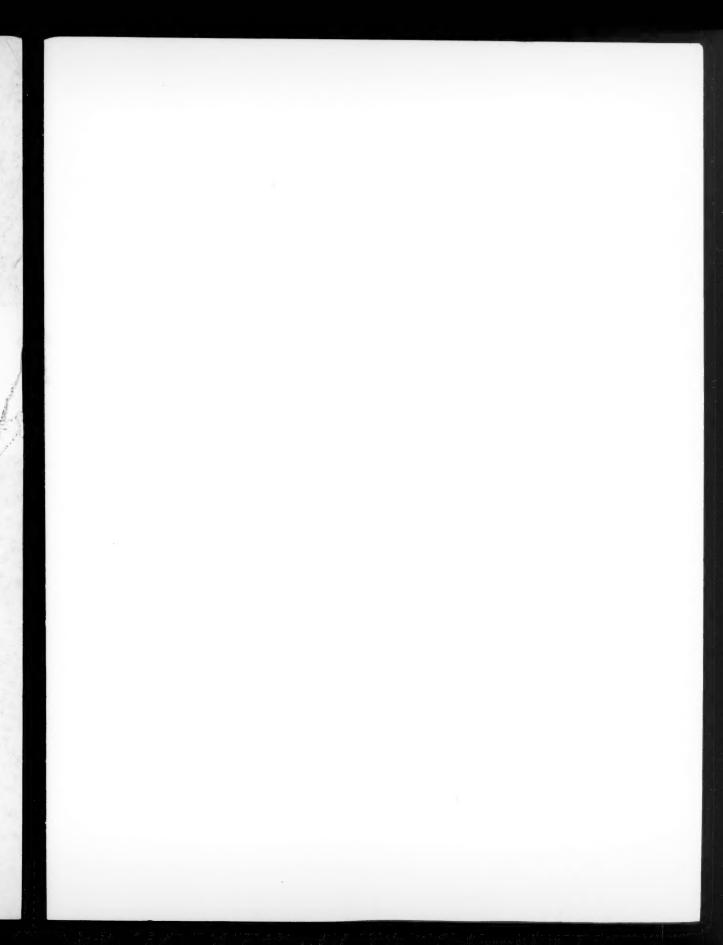
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W88-07990	7B		W88-08074	2H		W88-08158	5F		W88-08242	5A
W88-07991	2F		W88-08075	2H		W88-08159	5B			21
	2G								W88-08243	
W88-07992			W88-08076	2H	The state of the s	W88-08160	5A		W88-08244	6G
W88-07993	2G		W88-08077	2H		W88-08161	5A		W88-08245	5B
W88-07994	5A	The state of	W88-08078	2H		W88-08162	5A		W88-08246	5B
W88-07995	21		W88-08079	2H		W88-08163	5B		W88-08247	5C
W88-07996	2G		W88-08080	2H		W88-08164	5F			
W88-07997	21		W88-08081	5C		W88-08165	5A .		W88-08248	5A .
									W88-08249	5B
W88-07998	3F		W88-08082	5C	4.	W88-08166	5B		W88-08250	5F
W88-07999	5B		W88-08083	5C		W88-08167	7B		W88-08251	5C
W88-08000	2G		W88-08084	6G		W88-08168	5A		W88-08252	5A
W88-08001	8D		W88-08085	6E	. 20.	W88-08169	7B			
W88-08002	5A		W88-08086	5F		W88-08170	5C		W88-08253	5A
	5F		W88-08087	2L		W88-08171	5D		W88-08254	5A.
W88-08003									W88-08255	5C
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W88-08005	5E		W88-08089	2L		W88-08173	5A		W88-08257	5D
W88-08006	5D		W88-08090	2L	, 171	W88-08174	5B			
W88-08007	5D		W88-08091	5B		W88-08175	2G		W88-08258	5C
W88-08008	5D		W88-08092	2L		W88-08176	2F		W88-08259	5C
					11-11				W88-08260	2H
W88-08009	5B	1000 1000	W88-08093	5C	* * * * * * * * * * * * * * * * * * * *	W88-08177	2F		W88-08261	7B
W88-08010	5D		W88-08094	2H		W88-08178	2A			7
W88-08011	5A	9 14	W88-08095	2H		W88-08179	8B		W88-08262	5C
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								0-1	W88-08265	2K
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W88-08017	2L	4 44 1 31 41	W88-08101	2J	314	W88-08185	4B		W88-08268	7B
W88-08018	2L		W88-08102	2H		W88-08186	2L		W88-08269	2H
	5C					W88-08187	4B		W88-08270	2H
W88-08019			W88-08103	2H					W88-08271	2H
W88-08020			W88-08104	2H		W88-08188	5B			
W88-08021	2K		W88-08105	5C	,	W88-08189	5B		W88-08272	2H
W88-08022	5A	. 91	W88-08106	2H		W88-08190	2C		W88-08273	2H
W88-08023	2E		W88-08107	2E		W88-08191	8B		W88-08274	2H
W88-08024			W88-08108	2H		W88-08192	8G		W88-08275	2H
									W88-08276	2H
W88-08025			W88-08109	2H		W88-08193	8A	1		
W88-08026	2H		W88-08110	2H	,	W88-08194	8G		W88-08277	2H
W88-08027	2C		W88-08111	2H		W88-08195	8D		W88-08278	2H
W88-08028	8A		W88-08112	5B		W88-08196	8D		W88-08279	2H
W88-08029			W88-08113	2H		W88-08197	5B		W88-08280	2H
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W88-08030		6	W88-08114							
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W88-08032	5E		W88-08116	2B		W88-08200	5C		W88-08283	2H
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W88-08034	2G	-01	W88-08118	2B		W88-08202	2L		W88-08285	5C
W88-08035			W88-08119			W88-08203	2D		W88-08286	-
					- 1				W88-08287	5G
W88-08036			W88-08120			W88-08204	5D			
W88-08037			W88-08121	2B		W88-08205	2B		W88-08288	
W88-08038	4C		W88-08122	2B		W88-08206	2B	1	W88-08289	2H
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W88-08040			W88-08124			W88-08208	5E		W88-08291	2G
W88-08041			W88-08125					Lived and the second	W88-08292	
						W88-08209				
W88-08042			W88-08126		0.00	W88-08210			W88-08293	
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W88-08045			W88-08129			W88-08213			W88-08296	5B
W88-08046			W88-08130		I THE STATE OF	W88-08214			W88-08297	
W88-0804		15			The same of the same of				W88-08298	
			W88-08131			W88-08215				
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W88-08050	0 2E	,	W88-08134	5B		W88-08218	2L	*.	W88-08301	5C
W88-0805			W88-0813			W88-08219			W88-08302	
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W88-0805	5 2J		W88-08139	5D		W88-08223			W88-08306	2G
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			W88-0814		2 2 2					
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W88-0806	0 2B		W88-0814			W88-08228	5F		W88-08311	2G
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						W88-08230			W88-08313	
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W88-08319	3B		W88-08403	5D				SC				W88-08571	5B	
W88-08320	5B		W88-08404	5G	. 5		W88-08488 5	SC				W88-08572	5G	
			W88-08405	5D	. 8		W88-08489 5	SC	-0			W88-08573	5B	
W88-08321	2B							SC.				W88-08574	7A	
W88-08322	7B		W88-08406	5D					-					
W88-08323	5B		W88-08407	5A	. 8		W88-08491 2	L				W88-08575	5B	
W88-08324	5B		W88-08408	8A			W88-08492 5	5C				W88-08576	5D	
					. ,			SC					5D	
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W88-08326	5B		W88-08410	5E			W88-08494	5C				W88-08578	5D	
W88-08327	2J		W88-08411	5C			W88-08495 5	5B				W88-08579	5D	
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W88-08328	5G		W88-08412	2B								W88-08580	5D	
W88-08329	5B		W88-08413	5B			W88-08497	7B				W88-08581	5A	
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W88-08333	2F		W88-08417	5B			W88-08501 1	7B	-			W88-08585	2H	
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W88-08334	2F		W88-08418	5G					-			W88-08586	2H	
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								2.J				W88-08588		
W88-08337	2F		W88-08421	6B	*							W88-08589	2H	
W88-08338	8B		W88-08422	5B			W88-08506	5G .				W88-08590	2H	
W88-08339	2G		W88-08423	5A			W88-08507	2F						
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W88-08343	4A		W88-08427	5E								W88-08595	5A	
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W88-08345	2L		W88-08429	8A			W88-08513	5G						
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W88-08346	2L		W88-08430	5F								W88-08598	5C	
W88-08347	2L		W88-08431	5E			W88-08515	5G						
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W88-08348	2F											W88-08600	5B	
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								7A				W88-08603	2A	
W88-08352	8B		W88-08436	5B								W88-08604	6G	
W88-08353	5G		W88-08437	5A			W88-08521	7A						
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W88-08368	7B		W88-08452	5B			W88-08536							
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									2				2H	
W88-08377	6B		W88-08461	2K			W88-08545	3C				W88-08628		
W88-08378	5G		W88-08462	5B			W88-08546	5A				W88-08629	2H	
W88-08379	5G		W88-08463	5B			W88-08547	2.3				W88-08630	2E	
W88-08380			W88-08464	5B			W88-08548	4A				W88-08631	2H	
W88-08381	5F		W88-08465	5B			W88-08549	5D				W88-08632	2F	
W88-08382			W88-08466	7B			W88-08550	5D	-4			W88-08633	2H	
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W88-08383	3F		W88-08467	7B			W88-08551	5G				W88-08634	2H	
W88-08384	81		W88-08468	5B			W88-08552	6E	FI .			W88-08635	2H	
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W88-08386			W88-08470					5A				W88-08637		
W88-08387	5E		W88-08471	7B			W88-08555	5A				W88-08638	7B	
W88-08388			W88-08472				W88-08556	5D				W88-08639	2H	
							W88-08557							
W88-08389			W88-08473					-5A				W88-08640		
W88-08390	5G		W88-08474	7C			W88-08558	5B				W88-08641	2L	
W88-08391			W88-08475				W88-08559	2E				W88-08642	5B	
							W88-08560	2H				W88-08643		
W88-08392			W88-08476											
W88-08393	4A		W88-08477	7B			W88-08561	5B				W88-08644	2H	
W88-08394			W88-08478				W88-08562	5C				W88-08645		
							W88-08563				V	W88-08646		
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W88-0839			W88-08481				W88-08565	5C				W88-08648	5B	
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W88-0839			W88-08482				W88-08566	5D						
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			W88-08485											
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W88-08654	7B		W88-08731	2K		W88-08808	5B		W88-08885	5C
W88-08655	5F		W88-08732	2L		W88-08809	2H		W88-08886	2H
W88-08656		6		5C		W88-08810	2H			
	6A		W88-08733						W88-08887	2L
W88-08657	6A		W88-08734	2L		W88-08811	SC ·		W88-08888	2L
W88-08658	6E		W88-08735	5C		W88-08812	2H		W88-08889	5E
W88-08659	5B		W88-08736	5A		W88-08813	5A		W88-08890	5E
W88-08660	2F		W88-08737	2L		W88-08814	2H			
		1000	W 88-08/3/			W 00-U0014			W88-08891	5C
W88-08661	2F		W88-08738	2L		W88-08815	2H		W88-08892	5C
W88-08662	2A		W88-08739	2L		W88-08816	2H		W88-08893	5C
W88-08663	5G		W88-08740	21		W88-08817	2L	**		
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W88-08664	2E		W88-08741	2L		W88-08818	2L		W88-08895	5A
W88-08665	2H		W88-08742	5C		W88-08819	2H		W88-08896	2K
W88-08666	7B		W88-08743	21.		W88-08820	5C			
W88-08667	2E	11.00	W88-08744	2L		W88-08821	2H		W88-08897	5B
									W88-08898	21
W88-08668	2E		W88-08745	21		W88-08822	2H		W88-08899	5A
W88-08669	2G		W88-08746	2K		W88-08823	2H			
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W88-08672	5C		W88-08749	6E		W88-08826	5C			
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W88-08674	5C		W88-08751	2L		W88-08828	2H		W88-08904	5G
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W88-08675	5C		W88-08752	5B		W88-08829	2H			
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W88-08677	5C		W88-08754	5B		W88-08831	2H		W88-08907	5B
W88-08678	5C		W88-08755	4C		W88-08832	5C		W88-08908	5D
W88-08679	5B		W88-08756	4C		W88-08833	2H	5	W88-08909	5D
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W88-08682	5B		W88-08759	5B	-	W88-08836	5D		W88-08912	2G
W88-08683	5B		W88-08760	5D		W88-08837	2H		W88-08913	8B
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W88-08685	5C		W88-08762	5D		W88-08839	2H			
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W88-08686	5C		W88-08763	5B		W88-08840	21		W88-08916	2E
W88-08687	5C		W88-08764	5E		W88-08841	5C		W88-08917	5B
W88-08688	5C		W88-08765	2H		W88-08842	2H			
	5C			2H			5C		W88-08918	5D
W88-08689			W88-08766			W88-08843			W88-08919	6C
W88-08690	8D		W88-08767	2H		W88-08844	2H		W88-08920	5F
W88-08691	8D		W88-08768	2H		W88-08845	5C			
W88-08692	8D		W88-08769	2H		W88-08846	2H		W88-08921	5F
									W88-08922	5F
W88-08693	8E		W88-08770	2H		W88-08847	2L		W88-08923	5F
W88-08694	8E		W88-08771	2H	,	W88-08848	5B		W88-08924	
W88-08695	8E		W88-08772	2H	21/14/	W88-08849	2H			4B
W88-08696	8A		W88-08773	2H	27,47	W88-08850	2H		W88-08925	2L
			W 00-00//3						W88-08926	2L
W88-08697	8E		W88-08774	2H		W88-08851	18			2L
W88-08698	8A		W88-08775	2H		W88-08852	5F		W88-08927	
W88-08699	8E		W88-08776			W88-08853	5G		W88-08928	2L
									W88-08929	2L
88-08700	8E		W88-08777	2H		W88-08854	6E		W88-08930	2L
88-08701	8E		W88-08778	2H		W88-08855	5C			
W88_08707	8E		W88-08779	2H		W88-08856	2J		W88-08931	2L
W 88 00702									W88-08932	2L
W88-08702 W88-08703 W88-08704	8E		W88-08780			W88-08857	5B		W88-08933	2L
	8E		W88-08781	2H		W88-08858	5B			
W88-08705	8E		W88-08782	2H		W88-08859	5B	,	W88-08934	2L
W88-08706	8E		W88-08783				5C		W88-08935	2L
W 00-00700						W88-08860			W88-08936	2L
W88-08707	8E		W88-08784			W88-08861	5C			
W88-08708	8E		W88-08785	5C		W88-08862	5B		W88-08937	2L
W88-08709	2L		W88-08786	2H		W88-08863	5A		W88-08938	2L
W88-08710	5A					W88-08864			W88-08939	2L
			W88-08787				5A		W88-08940	2L
W88-08711	2J		W88-08788	7B		W88-08865	5G			
W88-08712	5B		W88-08789	2H		W88-03866	5E		W88-08941	5B
W88-08713	21		W88-08790			W88-08867	5B		W88-08942	2B
									W88-08943	2B
W88-08714	5B		W88-08791	5D		W88-08868	5C			
W88-08715	5B		W88-08792	5C		W88-08869	5G		W88-08944	2B
W88-08716			W88-08793		1"	W88-08870			W88-08945	2B
					1		5D		W88-08946	
W88-08717	2L		W88-08794			W88-08871				
W88-08718	5B		W88-08795	2L	1	W88-08872	2H		W88-08947	5B
W88-08719	2L		W88-08796	2H	7	W88-08873	2H		W88-08948	5B
W88-08720					0				W88-08949	5B
		1	W88-08797		30 3	W88-08874				
W88-08721	2L		W88-08798		4.3.1	W88-08875			W88-08950	
W88-08722	21	* ,-	W88-08799	5D		W88-08876	5A		W88-08951	2K
W88-08723		1	W88-08800			W88-08877	2L		W88-08952	2B
		11							W88-08953	2A
W88-08724		(5)	W88-08801			W88-08878				
W88-08725			W88-08802			W88-08879			W88-08954	8B
W88-08726	2H	. 1	W88-08803	2 K		W88-08880	5C		W88-08955	8B
W88-08727			W88-08804			W88-08881	5E		W88-08956	
			W 00-0000	45		11/00-00001	(T)			
W88-08728		1	W88-08805			W88-08882	5D		W88-08957	
W88-08729	5C		FW88-08806	5 2H		W88-08883	5C		W88-08958	2K
W88-08730	2L		W88-08807	7 5A		W88-08884			W88-08959	2F
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